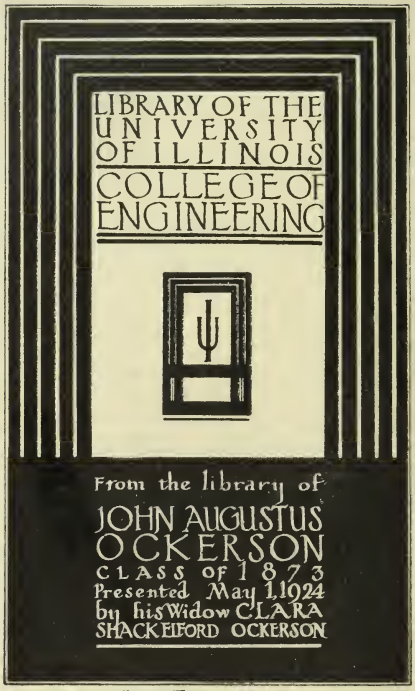

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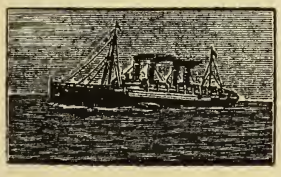
Permanent International Association of Navigation Congresses

X^th. INTERNATIONAL NAVIGATION CONGRESS. — MILAN 1905

REPORT

OF

PROCEEDINGS

NAVIGARE  NECESSE

MILAN

ORGANISING COMMITTEE OF THE CONGRESS — SECRETARIAL DEPARTMENT.

3, Via Sala, 3

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1906

This report has been drafted by Mr. Edmond Sanjust di Teulada, ingénieur en chef du Génie Civil at Milan, and general secretary of the Congress.

The reports of proceedings of the four meetings of Sections I and II, have been drafted respectively from shorthand notes by Messrs. Carlo Valentini, ingénieur en chef du Génie Civil at Ferrara, general Secretary of the Committee of Section I, and Domenico Lo Gatto, ingénieur en chef du Génie Civil at Leghorn, general Secretary of the Committee of Section II.

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INTRODUCTION

With a view to ensure continuity in international gatherings, the VIIIth International Congress of Navigation held in Paris in 1900, resolved at its last meeting on July 30 to convert the Preliminary Commission which had been constituted at the Brussels Congress of 1898, into a Permanent International Association of Navigation Congresses with a head office at Brussels.

The IXth International Congress and last of these autonomous congresses was held at Dusseldorf in 1902, from June 30 to July 5. In the report which M. Rota, lieutenant colonel of Naval Engineers and delegate of Italy, submitted on that occasion to his Government, allusion was made to the possibility of holding the Xth Congress in Italy at Milan in 1905.

This proposal was accepted and at a meeting of the Permanent Comission, held in Brussels on June 8, 1903, M. Torri, inspecteur supérieur du Génie Civil and the aforesaid M. Rota jointly presented, after receipt of official instructions to that effect, the offer of the Italian government to hold the Xth Congress at Milan. This proposal was accepted by the Permanent Commission.

The Italian delegates thereupon proceeded to organise the local Commission and at a meeting of the Permanent Commission, held at Brussels on May 2, 1904, they introducedM.Sanjust di Teulada, ingénieur en chef du Génie Civil of Milan, whom they had chosen as the general secretary of the future Congress. They also submitted complete lists of names for the various Committees of the Congress and suggestions regarding the dates of the meetings, the manner of employing the time, excursions and the subject matter of papers to be considered.

The proposals of the Italian delegates were approved by the Commission with some amendments concerning the questions and communications to be dealt with. Thenceforth the local organising Commission entered upon its functions and the success of the Congress was assured.

Patrons of the Congress and Local Commissions

His Majesty the King of Italy kindly accorded his gracious patronage of the Milan Congress. But Royal patronage did not confine itself to honorary attributions. His Majesty was good enough to place the Villa Reale at Milan with its dependencies and staff at the disposal of the Organising Commission during three months. Their Majesties the King and Queen honoured the inaugural meeting by their presence.

Italians are very proud that their beloved sovereigns should have given their official imprimatur to the work of the International Association on the occasion of its first congress. We feel that we interpret the unanimous wish of all the members of the Congress in taking this occasion of recording their gratitude towards their Majesties the King and Queen of Italy for their gracious attendance and for the royal privileges accorded to the Congress.

Reports and Communications.

The agenda of the Congress, which contained eight questions and thirteen communications covering the two sections of Inland and Ocean Navigation, was issued in June 1904. With a view to obtain the best results, foreign delegates were entrusted by the Secretarial Department with the propaganda in their respective countries.

This measure was a complete success as the number of reporters exceeded all expectations.

The following table shows the distribution of reports and communications according to their country of origin :

CLASSIFICATION OF REPORTS AND COMMUNICATIONS	PAPERS ACCORDING TO COUNTRY OF ORIGIN											
	Italy : papers	Italy general reports.	Germany.	Great Britain.	Austria.	Belgium.	Denmark.	United States.	France.	Netherlands.	Russia.	Totals.
Inland Navigation :												
Reports.	3	4	4	1	5	2	—	2	5	1	2	29
Communications . . .	3	5	5	1	1	2	—	2	—	—	3	22
Ocean Navigation :												
Reports.	10	4	5	3	—	—	1	1	4	—	2	30
Communications . . .	10	6	5	1	—	3	—	6	6	—	1	36
Totals . . .	26	19	19	6	6	7	1	11	15	1	8	117

The papers were published in French, German and English, in accordance with the rule followed by the organisers of the Paris and Dusseldorf Congresses.

All the work relating to the publication of the reports was entrusted to the Secretarial Department of the Association at Brussels, and the warm thanks of the local organising commission are due to the General Secretary M.Alexis Dufourny, ingénieur en chef des Ponts et Chaussées of Belgium, for having, in a relatively short space of time, issued a considerable number of reports in three languages in time for distribution before the opening of the Congress.

Various Publications.

In accordance with the practice adopted at all previous Congresses, each member was supplied with a guide-book giving general particulars regarding the sections ; plans and other

information likely to be of use to members of the Congress during the meetings were also provided.

The Ministry of Public Works and the Ministry of Marine of Italy who initiated the Congress, took the necessary steps to ensure a successful meeting and were good enough to present members of the Congress with certain publications as a memento of a meeting which had been desired for so long by all Italian experts on navigation questions.

The Ministry of Public Works presented two volumes : the first containing photo engravings of lakes, rivers, navigable canals, a chart and several plans ; the second which deals with seaports, containing plans of the principal ones, diagrams of ports of secondary importance and photographic illustrations.

These two volumes excited considerable interest amongst the members of the Congress and gave them a general idea of the public works which have hitherto been carried out in Italy.

The Ministry of Marine presented two volumes, one dealing with ancient ports, with plans and reproductions of old charts ; and the other dealing with lighthouses and the buoying of Italian coasts, a matter of international interest to navigation.

The Town Council of Milan, also presented a guide-book with historical and artistic data and information concerning the more important public services, charitable institutions, public works, museums, etc.

All these publications were duly distributed in the member's pigeon-holes in one of the buildings of the Villa Reale.

Members of the Congress.

As we have just explained, the Congress is the first which has been organised under the joint auspices of the International Association at Brussels and of one of the Government enrolled as a member of the Association. The procedure followed on this occasion will, we hope, serve as a precedent for future congresses.

We must again call attention to the fact that the members of the Congress are divided into two categories : permanent members, enrolled as members of the International Association, and temporary members, who become members only for a partilar congress.

This distinction is a necessary one and should be preserved in future congresses.

The following table indicates the number of members for each country.

COUNTRY	MEMBERS ENROLLED		Total number enrolled	Number who actually attended the Congress
	Permanent Association	Temporary Members		
Germany	346	139	485	193
Belgium	226	41	267	78
France	181	102	283	102
Austria	135	94	229	100
Italy	78	296	374	274
United States	73	25	98	8
Russia	72	20	92	16
Netherlands	58	16	74	27
Denmark	48	1	49	4
Great-Britain	37	20	57	11
Switzerland	26	3	29	3
Spain	11	3	14	9
Rumania	9	—	9	2
Portugal	6	5	11	3
Argentina	4	—	4	4
Hungary	4	—	4	11
Chile	3	1	4	2
Dutch Indies	3	—	3	—
Mexico	3	—	3	—
China	2	1	3	1
Norway	2	2	4	—
Servia	2	—	2	—
Sweden	2	4	6	4
Brazil	1	—	1	—
Cape Colony	1	—	1	—
Phillipines	1	—	1	—
British India	1	—	1	—
Japan	1	5	6	3
Liberia	1	—	1	—
Monaco	1	—	1	—
New Zealand	1	—	1	—
Peru	1	—	1	—
Siam	1	—	1	—
Totals	1,341	778	2,119	855

The attendance has been arrived at by taking the number of medals distributed at the local office. There is reason to believe that the number who actually attended the Congress is in excess of this computation and may be estimated (including non-subscribing members of countries) at about 1000.

Countries which are members of the Congress, and their delegates.

We must also recall the fact that the International Association includes a considerable number of States which are members. These countries are shown on the following table in which we have thought it would be useful to indicate, from data furnished in the report of the Executive Committee on the general conditions of the Association on July 31, 1905, the amount of the annual grant from the various countries, and the subscriptions from corporate bodies and from members.

Table of countries which are members of the Association

Serial number	COUNTRY	Amount of annual Government grant		Amount subscribed by corporate bodies	Amount subscribed by members	Grand total for each country
		Currency of the Country	Equivalent in Francs			
1	Belgium.	—	8,000	1,005	2,050	11,055
2	Germany	4,000 Marks	5,000	2,480	2,550	10,030
3	France	—	5,000	920	1,440	7,360
4	United States	1,000 Dollars	5,000	20	600	5,620
5	Russia	1,875 Roubles	5,000	—	430	5,430
6	Japan.	2,000 Yen	5,000	—	10	5,200
7	Austria	2,000 Kronen	2,080	600	1,030	3,710
8	Italy	2,500 Lire	2,500	30	680	3,210
9	Netherlands	1,200 Florins	2,500	110	470	3,080
10	Portugal	—	3,000	20	30	3,050
11	Hungary	2,000 Kronen	2,080	—	30	2,110
12	Spain.	—	2,000	20	80	2,100
13	Argentina	2,000 Fr.(Gold)	2,000	10	20	2,030
14	Rumania	—	1,500	—	80	1,580
15	Denmark	—	1,000	105	350	1,455
		Carried forward	51,660	5,320	9,850	66,730

Serial number	COUNTRY	Amount of annual Government grant		Amount subscribed by corporate bodies	Amount subscribed by members	Grand total for each country
		Currency of the country	Equivalent in Francs			
		Brought forward	51,660	5.320	9,850	66,730
16	Norway	750 Kronen	1,070	—	10	1,080
17	Chile	—	1,000	—	20	1,020
18	China.	—	1.000	10	10	1,020
19	Mexico	—	1,000	—	20	1,020
20	Congo	—	1,000	—	10	1,010
21	Peru	—	1,000	—	—	1,000
22	Danube (European States) .	—	500	—	—	500
23	Switzerland	—	250	150	90	490
24	Great Britain	—	—	30	310	340
25	Monaco	—	250	—	10	260
26	Siam	—	250	—	10	260
27	Servia	—	—	—	20	20
28	Turkey	—	—	—	20	20
29	Brazil	—	—	—	10	10
30	Sweden	—	—	—	10	10
31	Philippines.	—	—	—	10	10
32	British India	—	—	—	10	10
33	Dutch Indies	—	—	—	10	10
34	Liberia	—	—	—	10	10
35	New Zealand	—	—	—	10	10
36	Cape Colony	—	—	—	10	10
		Totals . Fr.	59,070	5,510	10,460	75,040

We think it desirable to point out an objection which arose at the Milan Congress in respect to the position of delegates from foreign countries.

The Italian government justly considered it necessary to invite the various foreign States with whom diplomatic relations were satisfactory, to participate in the Congress, this invitation being transmitted through the Ministry of Foreign Affairs and

the Ambassadors of H. M. the King of Italy accredited to the various foreign countries.

Some of these countries, adherents of the Association, forgetting possibly, that they were already represented by permanent delegates on the Brussels Commission, appointed other delegates.

In some instances, therefore, one country would be represented by two delegations, and although no objection could be taken to the increase in the number of delegates, it gave rise to a duality of representation which it is advisable to avoid.

We consider, therefore, that it would be desirable to transmit the invitation to participate to the various foreign States by a protocol which would emanate jointly from the Permanent International Association and the Ministry of Foreign Affairs of the country in which the Congress is held.

No difficulty will be experienced in drafting this invitation on diplomatic lines so as to avoid the objections referred to and thus prevent little misunderstandings which, insignificant in themselves, might impair the success of the Congress or at all events affect the participation of the various States.

Permanent International Commission.

A meeting of the Permanent International Commission was held prior to the Milan Congress. This meeting took place in the Yellow room which is reserved for the Presidency of the International Association. Important resolutions were carried at this meeting. These resolutions embodied the steps to be taken to obtain a reasonable number of reports and to ensure, by the intervention and influence of foreign delegates, that these should be written by leading authorities so as to constitute a valuable contribution to the progress of the Science.

It is needless to dwell at length upon the deliberations of the Commission as our Report of Proceedings deals exclusively with the Milan Congress. We have, however, much pleasure in being able to state that the meeting of the Commission held at Milan in September 1905 will have a great influence upon the organisation of future Congresses.

Excursions.

The main portion of this publication is devoted to a record of the official work of the Congress but, in accordance with precedent for publications of this kind, we have thought it desirable to give a short account of the various excursions which took place, pointing out at the same time the technical object of most of them.

The trips we organised at the time of the Milan Congress always had the twofold object of combining on the same day a technical excursion with a picturesque one.

The trip of September 20th to Como, Adda, the Electric works of Paderno, the works at Trezzo and the simple excursion to Como, were organised on this principle. Similarly the excursion of September 28th to the Victor-Emmanuel III canal and the electric works of Vizzola, was followed by a pleasure trip on Lake Maggiore.

The last two excursons were, however, an exception to the above rule. One was specially devoted to inland navigation, that is to say to navigation on the Po up to Chioggia and to the lagoon of Venice, an admirable terminus to a technical trip. The other journey was specially devoted to ocean navigation and enabled those who participated to become acquainted with our chief seaports of Genoa and Naples and wirth our important arsenal at Spezzia, the trip terminating at the marvellous bay of Naples, near to the ruins of Pompeii at the base of Vesuvius. It was therefore possible in this single journey to witness the most important technical works of our ocean navigation and at the same time admire the world renowned scenery which was disclosed on approaching the Tyrrhenean coast from the sea.

We cannot conclude these introductory remarks which touch briefly upon the various divisions of our Report of Proceedings, without rendering our warmest thanks to all those who, by their truly valuable assistance, have contributed to the succes of this first Navigation Congress in Italy. This Congress had long been desired by Italians; they wished to show their foreign guests that in their country, the ancient birth-place of

navigation, the renascence of inland navigation in the plains of Lombardy, brought to perfection by Leonardo da Vinci, is ever present in the minds, and also that they still maintain the traditions of their sailors who, following the exemples of Marco Polo and Christopher Columbus, have carried the respected names of Venice and Genoa to far-off lands.

Our Congress plaquettes and medals are inscribed with the names of Leonardo and Columbus — who typify inland and ocean navigation,respectively — and recall two glorious episodes in history which henceforth belong not only to Italy alone but also to the whole scientific world.

Italy is quite a young nation which follows feverishly the lead of the older nations which she considered in the past in the light of barbarians. She no longer intends to live upon the traditions of her glorious past. The Romans have slept too long a sleep in their sculptured sarcophagii for us to derive any benefit from their exploits. Italy is blossoming into a new and modern existence. Her magnificent artistic renascence must also have its corollary in an industrial, commercial and economic renascence. It behoves the descendants of Christopher Columbus to regain their former reputation of entrepid and successful navigators. The duke of the Abruzzi and Cagni have led the way ; others will follow.

GENERAL INFORMATION

Milan. — The Royal Villa, in which the Congress was held.

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§ 1. — Committees

PATRONS

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S. A. IL PRINCIPE TOMMASSO DI SAVOJA

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S. E. il Ministro dei Lavori Pubblici.
S. E. il Ministro della Marida.

Committee of Patronage.

PRESIDENTS

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S. E. il Sotto Segretario di Stato per la Marina.
S. E. il Sotto Segretario di Stato dei Lavori Pubblici.
Il Presidente del Consiglio Superiore di Marina.
» del Consiglio Superiore dei LL. PP.
» del Collegio degl'Ingegneri di Milano.

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» » delle costruzioni navali.
» » della marina mercantile.
» » dell'industria e del commercio.
» » delle bonificazioni e dei porti.
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Cajo comm. **Ausano**, Direttore Generale delle ferrovie dello Stato, Roma.
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Martinez comm. **Gabriele**, Vice Ammiraglio a riposo, Firenze.
Masdea comm. **Edoardo**, Magg. Gen. del Genio Navale, Roma.
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Orlando on. **Vittorio Emanuele**, Deputato al Parlamento, Roma.

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Pirelli comm. ing. **G. B.**, Milano.
Pisa Ugo, Senatore del Regno, Milano.
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Porro nobile **di S. Maria della Biocca Carlo**, Colonnelle di Stato Maggiore, Roma.
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Raineri cav. **Salvatore**, Capitano Marittimo, Genova.
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von Euting, » Württembergischer Präsident.

von Schaal, » » Oberbaurat.

Pfleiderer, Königlich Württembergischer Regierungsrat.

Honsell, Grossherzoglich Badischer Oberbaudirektor.

Rossirt, » » Baurat.

Kupferschmid, Grossherzoglich Badischer Oberbauinspektor.

Imroth, Grossherzoglich Hessischer Geheimer Oberbaurat.

Mensch, Grossherzoglich Meklenburgischer Oberbaudirektor.

Brinckmann, Herzoglich Braunschweigischer Geheimer Baurat.

Rehder, Oberbaudirektor der freien und Hansestadt Lübeck.

Bücking, Oberbaudirektor der freien und Hansestadt Bremen.

Bubendey, Wasserbaudirektor der freien und Hansestadt Hamburg.

Winter, Kaidirektor der freien und Hansestadt Hamburg.

Germany : **Willgerodt,** Kaiserlicher Ministerialrat und Wasserbaudirektor.
von Traut, Kaiserlicher Ministerialrat.

France : **Quinette de Rochemont,** Inspecteur général des Ponts et Chaussées, Directeur des Phares et Balises, Président.
Mallet, Membre de la Chambre de Commerce de Paris.
Michaud, Membre Secrétaire de la Chambre de Commerce.
Lefebvre, Membre Trésorier de la Chambre de Commerce.
Peltereau Placide, Membre de la Chambre de Commerce.
Marsaux, Membre de la Chambre de Commerce.
Dabat, Directeur de l'hydraulique et des améliorations agricoles.
Mengin-Lecreulx, Inspecteur Général des Ponts et Chaussées.
Guinard, Inspecteur Général des Ponts et Chaussées, Direct. de l'Ecole Nationale des Ponts et Chaussées.
Lévy Maurice, Inspect. Gén. des Ponts et Chaussées.

Guérard	»	»	»
Joly	»	»	»
Alexandre	»	»	»
Derome	»	»	»
Juncker	»	»	»
Vétillart	»	»	»

D'Hénouville, Chef de la Division de la Navigation au Ministère des Travaux Publics.
Girardon, Ingénieur en chef des Ponts et Chaussées.

La Rivière	»	»	»
Dusuzeau	»	»	»
Barbet	»	»	»
Barbé	»	»	»
Batard-Razelière	»	»	»
Cuenot	»	»	»
Bourgougnon	»	»	»

Arnaud, Ingénieur des Ponts et Chaussées.

France : **De Joly**, Ing. des Ponts et Chaussées, Secrétaire.
Le Vice-Président du Conseil Général des Ponts et Chaussées.
Le Directeur du Personnel et de la Comptabilité.
Le Conseiller d'Etat, Directeur des routes de la Navigation et des Mines, au Ministère des Travaux Publics.

United States : **H. F. Hodges**, Engineer, U. S. Army.
J. C. Sanford, Engineer U. S. Army.
J. A. Ockerson, Civil Engineer, Mississippi Commission.

Russia : **de Timonoff**, Professeur à l'Institut, Directeur des voies de communication de la région de Saint-Pétersbourg.
Henry Merczyng, Prof. à l'Institut des Ingénieurs, Ing. des voies de communication, Conseiller d'Etat.
Prince **Vsévolod Chakhovkoi**, fonctionnaire pour missions spéciales aux voies de communication.
Ing. **Paolo Tchekhovitch**, Conseiller d'Etat, Directeur des travaux du Port d'Odessa.
Lipine, Conseiller d'Etat.
Lokhitine, Conseiller d'Etat.
Jevane Stanislas, Ingénieur des voies de communication.

Japan : Prince **Sanetoron Itchijo**, Capitaine de Frégate, attaché naval du Japon à Paris.

Austria : **Schromm Anton**, Hofrat, K. K. Binnenschifffahrts-Inspector.
Hillinger Heinrich, Hofrat, Vorstand des hydrotechnischen Bureaus.
Kautzky Dr. **Heinrich**, Sectionsrat, Vorstand an dem Wasserstrassen- und Binnenschifffahrts-Departm.
Kuhn Richard, K. K. Baurat der Direction für den Bau der Wasserstrassen.
Gregoris Anton, Baurat der Lagerhäuser in Triest.

Austria :

Goldbach Joseph, K. K. Ministerialrat.
Lauda Ernst, Oberbaurat.
Herbst Arthur, Oberbaurat.
Markus Eduard, K. K. Hofrat.
Deutsch Dr. **Viktor**, K. K. Sectionsrat.
Köll Viktor, K. K. Ministerialrat.

Hungary :

Béla de Gonda, Conseiller Ministériel.
Farago Léopold, Consigliere de Lezione.
Iozsa Ladislas.
Steinaker Gabriel, Consigliere tecnico.
Jacques de Iahy, Segretario Ministeriale.
Louis de Hoszpotzky, Consigliere di Sezione.
Koloman de Kennessey, Regio consigliere et Ispettore capo delle Ferrovie ed imprese di Navigazione dello Stato Ungherese.
Hoszpotzky, Capo della Delegazione.
Dr. **August Neuchtern,** H. Magistratsrat.
Joseph Cssottbauer, Gemeinderat der Stadt Wien.
Heinrich.

Netherlands :

Van der Sleyden, Ph. W. ancien Ministre du Waterstaat.
Wortmann H., Ingénieur de 1re classe du Waterstaat.
Nelemans J., Ingénieur de 1re cl. du gouvernement
Deking-Dura Adrianus, Ing. en chef de la Province de l'Overyssel, Stationsweg, Zwolle.

Spain :

Don **Edoardo Lopez Navarro,** Inspecteur Général des Ponts et Chaussées et des Ports.
Don **Carlos de Augulo y Bertram,** Directeur des travaux du port de Barcelone.
Don **Julio Valdès y Hamaran,** sous-directeur des travaux du port de Barcelone.
Don **Luigi Malini y Uriborri,** Directeur des travaux du Guadalquivir et du Port de Seville.
Don **Garcia Arenal,** Directeur des travaux du Port Vigo.

Spain : Don **Guglielmo Brochmann y Abarzusa,** Ingenieur adjoint à la section des travaux hydrauliques au Ministère.
De la Puente y Bassave D. José, Directeur de 1re classe de la Marine marchande.
Texidor D. Jésus Maria y Alcalà del Oluro, Lieutenant de 3me classe de la Marine marchande.
Ortuno E., Ingénieur, Sénateur.

Argentine : **Besson Beltram,** Lieutenant de vaisseau, attaché naval auprès des Légations de l'Argentine à Paris et à Rome.

Roumania : **Saligny Angelo,** Inspecteur General, Directeur du service hydraulique et des travaux de construction du port de Constantza.

Denmark : Chr. **Otterstrom,** Directeur du service des eaux.
Chr. **Hümmel.**

Norway : **G. Satren,** Directeur de la canalisation.

China : Sig. **Tchai Tching-Svung,** Secrétaire de la Légation Impériale.

Danube : (Europ. Commiss.) **Deutsch** Ing. **James,** Président de l'Administration de la Société de navigation sur le Danube.
Frankl Ferdinand, Conseiller d'Administration de la Société de navigation sur le Danube.
Müller Otto, Conseiller d'Etat, chef de la Direction de la Société de navigation sur le Danube.
Suppan Carl Viktor, Inspecteur Supérieur de la navigation sur le Danube.

Switzerland : **de Morlot Albert,** Inspecteur Fédéral en chef des travaux publics.
Rusca Giovanni, Capitaine du Génie.

Great-Britain: Sir **Charles Morre Walson,** Engineer Colonel H. M. Army.
Sir **Francis Vernon-Harcourt,** Engineer.

§ 3. — Questions, Communications and list of publications

I SECTION : INLAND NAVIGATION

A. — QUESTIONS

1. Question : *On the advantages and organization of mixed Transports that is by Railways and Waterways.*

1. **Moschini, A.** — General Report.
2. **Whinery, S.** — A review of transportation and the relation of transportation agencies to each other in the United States.
3. **Captier, G.** — On the advantages and organization of mixed transportation that is by railways and waterways.
4. **Tavernier, R.** — On the utility and organization of mixed transportation in the South East of France.
5. **Crotti, G.**, and **Carrissimo, M.** — Aerial cableways as applied to the transport service of harbours.
6. **Maximoff, S.** — Advantages and organization of mixed transports.

2. Question : *Influence of Deforestation and of the Drying up of Marshes on the Sphere of Influence and on the Performance of the Rivers.*

7. **Cipoletti, C.** — General Report.

8. **Keller, H.** — Effect of deforestation and draining of marshes upon the regimen and discharge of rivers.

9. **Lauda, E.** — Influence of the destruction of forests and the drainage of marshes on the course and regimen of rivers.

10. **Riedel, J.** — Influence of the destruction of forests and of the draining of swamps on the conditions of flow and level of the rivers.

11. **Wolfschütz, J.** — Influence of the destruction of forests and of the draining of swamps upon the course and the regimen of rivers.

12. **Lafosse, H.-N.** — Influence of the destruction of forests and drainage of marshes.

13. **Ponti, E.** — Influence of the destruction of forests and drainage of marshes on the regimen and discharge of streams.

14. **Lokhtine, M.** — Influence of the destruction of forests and drainage of marshes on the regimen and discharge of rivers.

3. Question : *Investigations of the Methods best suited for surmounting great Differences of Level between the Reaches of Canals.*

15. **Crugnola, G.** — General Report.

16. **Gerdau, B.** — Study of systems for overcoming differences of level in canals.

17. **Herman, A.**, and **Prüsmann, A.** — Systems which are suitable for surmounting great differences in the levels of two canal reaches.

18. **Vernon-Harcourt, L.-F.** — Investigation of the methods best suited for surmounting great differences of level between the reaches of canals.

19. **Schromm, A.** — A study on the various methods of surmounting differences of level of canal reaches.

20. **Smrcek, A.** — Comparison of various systems of lifting boats, in respect of their working capacities and their importance as regards the proposed Danube-Oder canal in Austria.

21. **Genard, H.** — Study of the systems suited to overcoming high lifts between canal levels. Vertical lifts or inclined planes.

22. **Lefebvre, E.** — Study of systems suited to overcoming high lifts between canal levels.

23. **Symon, Th.** — Mechanical lift locks in America.

24. **de Bovet, A.** — On the systems best suited to surmounting great differences of level between the reaches of canals.

25. **Girola, M.** — On great differences of level from the point of view of mixed traffic.

26. **Wouter Cool** and **van Panhuys.** — Means for overcoming great differences of level.

4. Question : *Development of Inland Navigation by Means of Shallow-draught Vessels. Mode of Construction of these, and their Motor.*

27. **Fumanti, G.** — General Report.

28. **Blümcke, R.** — Development of the navigation carried on by vessels of shallow draught. Build and means of propulsion of these.

29. **Wahl, A.** — Development of inland navigation by means of light-draught boats. Mode of construction and motors.

B. — COMMUNICATIONS.

1. Communication : *A Study of Means of establishing Connection, by inland Waterway across the Alps between the Mediterranean, the Adriatic and Central Europe.*

30. **Paladini, F.** — General Report.

31. **Riedel, J.** — An enquiry into the feasibility of constructing a navigable waterway through the Alps to connect the Adriatic Sea and the Mediterranean with Central Europe.

2. Communication : *Economical and technical Study of the mechanical Traction of Boats on Rivers, Canals and Lakes.*

32. **Paladini, E.** — General Report.

33. **Köttgen, E.** — The electrical towage of vessels.

34. **Thiele, F.** — Economic study of the mechanical ship-train on rivers, lakes and canals.

35. **Thwaite, B.** — An economical and technical study of the mechanical traction of boats on rivers, canals and lakes.

36. **Snyers, R.** — Study of a new mode of mechanical and economical traction for boats.

37. **Clarke, St.-J.** and **Gerard, L.** — Economical and technical study of the mechanical traction of boats on rivers, canals and lakes, by American methods.

38. **La Rivière, G.** — Economical and technical study of the mechanical traction of boats on rivers and canals.

39. **Merczyng, A.** — Mechanical traction of boats proposed in Russia on the canals passing around lake Ladoga.

3. Communication : *The Mortgaging of Inland Shipping.*

40. **Berlingieri, Fr.** — General Report.

41. **Kisker, W.** — The mortgaging of inland shipping.

42. **de Sanctis, P.-E.** — Mortgaging of vessels engaged in internal navigation.

43. **Frola, M.** — Mortgages on vessels used for inland navigation.

4. Communication : *Have the Rivers flowing southward from the Alps the Characteristics, and are their hydraulic Conditions such, as to render possible the Institution of movable Dams like those in Use on northern Rivers to prevent the Fall of the Water Level with the Ebbing Tide, and to provide the necessary anchoring Ground for Shipping.*

No Reporter.

5. Communication : *Study of the Effects produced by the cutting of navigable Canals on the underground Water Systems.*

44. **de Sanctis, P.-E.** — General Report.
45. **Denil, G.** — Influence of canals on the domain of the underground waters.

6. Communication : *Results obtained by Dredging in Increasing the Depth of Water of Rivers. Technical and administrative Organization of Works undertaken with this Object.*

46. **Tornani, I.** — General Report.
47. **Roloff, E.** — Effect of dredging on river beds. Technical and administrative management of the operations performed for this purpose.
48. **Kretz, F.** — Effects produced on the beds of rivers by work done with Kretz dredgers. Technical and administrative management of such like operations.
49. **Ockerson, J.-A.** — Hydraulic dredges as used for the improvement of navigation on the Mississippi river.
50. **Sassi, E.** — Dredging in the bed of rivers. Tests made in Italy in 1904.
51. **Kleiber, G.** — Results obtained with dredging the shoals in the Volga between Kstovo and Bogorodsk.
52. **de Lélavski, N.** — Approfondissement des grands fleuves à fond mobile au moyen de travaux concurrents de régularisation et de dragage (œuvre posthume).

II. SECTION : OCEAN NAVIGATION

A. — QUESTIONS

1. Question : *Improvement of the Mouths of Rivers discharging into tideless Seas.*

53. **Turazza, G.** — General Report.
54. **Germelmann, W.** — Amelioration of the estuaries of rivers flowing into tideless seas.

55. **Guérard, A.** — Improvement of the mouths of rivers flowing into tideless seas. Works built and observations made at the mouths of the Rhône.
56. **Barcelloni, A.** — Protection works at the mouth of the Pô.
57. **Bruno, G.** — Notice on the arrangement of the mouths of rivers flowing into tideless seas and on the mouths of the river Pô.
58. **Orlando, F.** — Experiments on a working model in order to determine the possibility of improving the mouths of the Tiber for the purpose of maritime navigation.
59. **Tchekhovitch, F.** — Works of Improvement at the mouths of the Kelia Arm (Russian branch of the Danube).
60. **de Timonoff, V.-E.** — Improvement of the mouths of large rivers flowing into tideless seas.

2. Question : *Progress in Methods of Propulsion of Vessels. Effect of these on Channels and Harbours.*

61. **Soliani, N.** — General Report.
62. **Techel, M.**, and **Narten, G.** — Progress in Means for the propulsion of vessels. Consequences in regard to channels and harbours.
63. **Parsons, Ch. A. Hon.** — Parson's Marine Steam Turbine.
64. **See, H.** — Some stern facts.
65. **Lelong. M.** — Progress in the means of propulsion for ships. Its effect upon harbours and channels.
66. **Rota, G.** — Advance in the means for propelling ships.
67. **Pecoraro, N.** — Experimental researches on the action of propellers working under special conditions.

3. Question : *Review of the various Methods of Working and Administration of Seaports. Their Influence on the Development of Trade.*

68. **Mazza, A.** — General Report.
69. **Benduhn, N.** — Exposition of the different methods of working and of management of maritime harbours. Their influence on the development of traffic.

In sight of Bellagio (Lake Como).

70. **Winter, P.** — The seaport of Hamburg. Its management and working.

71. **Joly, P.** — Account of the various methods of administering and operating commercial ports.

72. **Lampugnani, L.** — Different systems of administration and operation for ports. Influence of these systems on the economic results of the management of seaports and on the commercial operations of the latter, from the point of view of Italian legislation as it concerns the autonomy of the port of Genoa.

73. **Gullini, H.** — Working of the port of Venice.

4. Question : *Conditions affecting the Force of Waves and the Construction of Breakwaters to resist them.*

74. **Lo Gatto, P.** — General Report.

75. **Anderson, M.** — The construction of the outer moles of ports with regard to the wave forces which they are to resist. Estimation of these forces.

76. **Vernon-Harcourt, L. F.** — Conditions affecting the force of waves and the construction of breakwaters to resist them.

77. **Cay, D.-W.** — Construction of outer breakwaters of harbours in view of the force of the waves wich they have to resist. Estimate of this power.

78. **Bech, C.** — Moles near Vorüpor and Hanstholm on the West Coast of Jutland, Denmark.

79. **de Joly.** — Construction of breakwater outside of seaports taking into consideration the force of the waves they must oppose. Determination of this force.

80. **Coen-Cagli, E.** — Works of defence of the port of Naples. Considerations on the structure and the shape of breakwaters outside of ports.

81. **Bastiani, F., D'Urso, F.,** and **Simoncini, E.** — Structure and form of breakwaters, built in Italian harbours.

82. **Bernardini, O.** — Construction of the outer moles of ports, having regard to the force of the waves which they have to resist. Estimation of this force.

B. — COMMUNICATIONS

1. Communication : *Rapid Increase in the Dimensions of Steamers and Sailings Vessels. Draught of Water of these. Effect of the Increase on the Harbours. Canals and approaches.*

83. **Jorini, A.** — General Report.

84. **Corthell, E.** — Maritime Commerce. Development in dimensions of vessels. Existing and proposed dimensions of ports.

85. **Vétillart, H.** — Dimensions of ships. Their rapid progression and its consequences.

86. **Verdinois, C.** — The rapid increase in the size of steamships and sailing vessels. Its effect upon ports.

2. Communication : *The Use of liquid Fuel for Purposes of Navigation.*

87. **Ancona, U.** — General Report.

88. **Melville, G.** — Liquid fuel for naval and marine uses.

3. Communication : *The Transport of Cargo by Ferry-Boats.*

89. **de Vito, E.** — General Report.

90. **Ashley, H.-W.** — Concerning car ferries navigating bays, sounds and lakes subject to the jurisdiction of the United States.

91. **Cucchini, E.** — Transportation of freight by ferry-boats.

92. **Rota, G.** — Goods transport by railways ferries.

4. Communication : *Report on the most recent works carried out in the principal seaports.*

93. **Bubendey, J.**, and **Schultze, L.** — The German maritime Harbours : Emden, Bremen, Harburg, Hamburg, Lübeck and Stettin.

94. **Van der Schueren, F.** — The maritime installations of the port of Ostend. Extension works.

95. **Nyssens-Hart, J.**, and **Piens, Ch.** — Account of the construction works at the Zeebrugge landing place.

96. **Grenier, L.**, and **Van Haute, G.** — Maritime canal from Ghent to Terneuzen and port of Ghent.

97. **Hodgdon, W.** — A description of some of the most recent works executed and in progress at the port of Boston, Massachusetts, U. S. A.

98. **Sullivan, J.** — Avanced methods of handling heavy commodities as exhibited in ports of the Great Lakes. System of North America.

99. **Quinette de Rochemont (Baron).** — Report on the works most recently carried out in the principal maritime harbours of France.

100. **Bernardini, O.** — New harbour works at Genoa and Savona.

101. **Cucchini, E.** — The grain elevator at Venice.

102. **Cucchini, E.** — The Lido entrance at Venice.

103. **Perilli, M.** — Jetties of armored concrete.

104. **Caizzi, L.** — Technical notice of the docks and of the port of Naples.

105. **Rojdesvensky, A.** — New work carried on in the maritime canal at Saint-Pétersbourg.

5. Communication : *Responsibility of Ship Owners in regard to private Parties or public Administrations.*

106. **Berlingieri, F.** — General Report.

107. **Charguéraud, A.** — Responsibility of ship owners in regard to private parties or public administrations.

108. **Verneaux, R.** — Responsibility of ship owners toward private parties or public administrations.

6. Communication : *Coast Signals. — Lightships. — Wireless Telegraphy.*

109. **Pullino, V.** — General Report.

110. **Körte, W.** — Beacons and fog signals on the Prussian coasts.

111. **Douglass, W.** — Lighthouse engineering in Great Britain.

112. **Ribière, C.** — Signals and lightships on the coasts of France.

113. **Cattolica, P.** — Lighthouses and signals from the standpoint of nautical requirements.

7. Communication : *Measures adopted by the different governments for the Protection of Ocean Navigation. Bounties. Reduced Railway Tariffs for Merchandise intended to be transported by Sea.*

114. **Soliani, N.** — General Report.

115. **Rosing, J.** — Measures taken by the different governments for the encouragement of navigation. Premiums and reduced railway charges for goods that are to be transported by sea.

116. **Bates, W.** — Measures adopted by the different governments for the protection of ocean navigation.

117. **Colson, C.** — Measures taken by the government for protecting maritime navigation in France.

118. **Bernardi, J.** — Measures taken by the Italian Government for assisting the merchant navy.

OTHER PUBLICATIONS

119. Guide du Congrès de Milan.

120. Milano nel 1905.

121. **Bormann, A.** — Les dernières dragues à godets construites en Russie (1re section).

122. **Sassi, E.** — La législation et la jurisprudence italienne par rapport aux fleuves et aux torrents navigables (1re section).

123. **Havestadt** und **Contag.** — Mitteilung der Teltowkanal-Bauverwaltung über die Machnower Schleuse (1. Abteilung).

124. **Havestadt** und **Contag.** — Mitteilung der Teltowkanal-Bauverwaltung über den elektrischen Schiffszug und die elektrische Treidelei auf dem Teltowkanal (1. Abteilung).

125. **Ministero della Marina.** — Monografia storica dei porti dell' antichità nella penisola italiana.

126. **Coen-Cagli, E.**, et **Bernardini, O.** — Ports maritimes. Notice illustrée.

127. **Cozza, L.**, et **Grillo della Berta, J.** — Lacs, fleuves et canaux de navigation. Notice illustrée.

128. **Pokorny, F.** — Ascenseur pour bateaux et navires (système Pokorny).

129. **Wilhelm, M.** — Concours International de Vienne pour un projet d'élévateur de bateaux. Compte rendu.

130. **Orlando, P.** — Roma porto di mare.

131. **Orlando, P.** — Roma porto di mare e la navigazione interna sul Tevere e sul Nera.

132. **Berni, A.** — Navigazione fluviale in provincia di Mantova nell'anno 1904.

133. **Cipoletti.** — Sistemazione del Tevere e delle vallata.

134. **Scotti, A.** — Le forze idrauliche del naviglio grande e l'impianto idroelettrico di Turbigo.

135. **Prüsmann.** — Vergleichung von Schleusen und mechanischen Hebewerken.

136. **Schultz, H.**, und **Wulle, K.** — Der Hafen zu Harburg, insbesondere seine in der Ausführung begriffene Erweiterung.

137. **Sympher, L.** — Die neuen wasserwirtschaftlichen Gesetze in Preussen.

138. **Umlauf, A.**, **von Stockert, L.** und **Offermann, C.** — Projekt für ein Schiffshebewerk bei Prerau.

139. **Umlauf, A.** und **von Stockert, L.** — Welches der beiden preisgekrönten Hebewerksprojekte soll ausgeführt werden?

140. **Boet, G.** — Le segnalazioni marittime.

141. **Czarnomski, W.** — Les moulinets comme moyens d'étudier le régime des cours d'eau et leur emploi dans la solution des problèmes hydrotechniques.

142. **Seifert, R.** — Die Anwendbarkeit der Ergebnisse der Flügeleichungen auf die Messungen im fliessenden Wasser.

143. **Inglese, I.** — Nuovo sistema di costruzione di moli.

144. **Doneaud, E.** — Porto Maurizio nel passato... al presente e sua missione nelle nuove vie di penetrazione.

145. **Migliardi.** — Progetto di un elevatore di navi tipo verticale, funicolare equilibrato.

146. **Bonaeira.** — Progetto di scafo a galleria subacquea longitudinale.

147. **Zdenko.** — The fish propeller.

148. **Consorzio per la Navigazione Interna nella Valle Padana.** — Memoria presentata al Congresso Internazionale di Navigazione.

149. **Zeitschrift für Binnen-Schiffahrt.** — Festnummer zum X. Internationalen Schifffahrts-Kongress in Mailand

§ 4. — List of permanent Members of the Association (1906)

Ackermans, H.-W., Entrepreneur, 120, chaussée de Malines, Anvers.
Acouloff, Constantin, Ingénieur des Voies de Communication, Lecteur au Cours de Navigation intérieure à l'Institut Polytechnique de Kieff, Institut Polytechnique, Kieff.
Adler, Max, Rechtsanwalt, 6[i], Markt, Döbeln i. Sa.
Adlerberg, Paul, Ingénieur des Voies de Communication, Sandomir (gouv. de Radom).
Aerts, Alphonse, Courtier maritime (firme John P. Best & C°), 13, avenue Van Eyck, Anvers.
Ahlefeldt-Laurvigen, Andreas, Directeur de Compagnie d'assurances maritimes, 24, Holmens Kanal, Copenhague.
Aichelburg, Ernst, (Graf), Ingenieur, Baukommissär der k. k. Seebehörde, 33, Via del Lazzaretto vecchio, Triest.
Albelda, José, Ingénieur du port de Huelva, Huelva (Espagne).
Albitzky, Basile, Professeur, Institut technologique, Kharkof (Russie).
Alexandre, Paul-Edouard, Inspecteur Général des Ponts et Chaussées, 18, rue Desbordes-Valmore, Paris.
Allard, Félix, Ingénieur-Entrepreneur, 46, avenue Kleber, Paris
Allen, Henry-Clayton, Civil Engineer, 206, Delaware Street, Syracuse (N. Y.) (U. S.).
Alston, William-Murray, Civil Engineer, 16, Robertson street, Glasgow (Scotland).
Ancion, Alfred (Baron), Ingénieur et Sénateur, 50, boulevard Piercot, Liége.
Ancona, Ugo, Ingénieur, Professeur de Mécanique, Institut Polytechnique, Milan.
Andersen, Niels, Conseiller d'Etat, Söholm pr. Hellerup.

Anderson, David J., Civil Engineer, U. S. Assistant Engineer, Engineer Office, U. S. Army, Mobile-Alabama.

Anderson, Herbert-William, Civil Engineer and Specialist in cement Fairfield, South Western Laboratory, 43, St. James' Road, Kingston (London).

Antonelli, Jean-Baptiste, Ingénieur, Via Galata, Gênes.

Arenal, Fernando-Garcia, Ingénieur en chef des Routes, Canaux et Ports, Directeur des travaux du port de Vigo, Vigo (Espagne).

Arimondi, Camillo, Ingénieur en chef du Génie Civil, Turin.

Arndt, Léopold, Ingénieur, Josefstädterstrasse, 31, Vienne VIII.

Arnken, Pierre, Ingénieur-Mécanicien et Architecte de Navires, Membre de l'Institut Royal des Ingénieurs, Maaskade, V. W. Z. 49, Rotterdam.

Arnold, Wilhelm, K. Regierungsassessor, 68ª, Türkenstrasse, München.

Aschmoneit, Franz, Königl. Preussischer Wasserbauinspektor, Beeskow (Prov. Brandenburg).

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von Pirko, Franz, Landes Ausschutz, Herrengasse, 13, Vienne.

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Werner, Georg, Regierungsrat, Gerbenstrasse, 3, Magdebourg.

Wessels, Johann-Friedrich, Senator, 86[1], Langestrasse, Bremen.

West, Charles-Hunter, M. Am. Assoc. C. E., Chief-Engineer Mississippi Levee District, Greenville (Mississipi U. S. A.).

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Winter, P., Direktor der Quaiverwaltung, Quaiverwaltung, Hamburg.

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Woitkiewicz, Michel, Ingénieur, Costroma (Russie).

Wolf, Charles, Ingénieur, Nidau (près Bienne).

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§ 5. — List of temporary Members being Members of the Congress of Milan only.

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Albertazzi, Ariberto, Ingegnere del Genio Civile, Genova.

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Albrecht, Gustave (M^me^), quai Van Dyck, 8, Anvers.

Alexandre (M^me^), place du Musée, 14, Bruxelles.

Alexandre, A., place du Musée, 14, Bruxelles.

Allegri dott. **Giulio**, Calle del Traghetto S. Benedetto, 3940, Venezia.

Alzona comm. ing. **Luigi**, direttore esercizio Rete Adriatica, rappresentante delle Strade Ferrate Meridionali, Rete Adriatica, Bologna.

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Angerer, Ernesto, Socio Gerente e Dirett. Amministr. della Società G. Bernardi e C., corso P. Nuova, 19, Milano.

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Ankenbrand, Andreas, k. Bauamtsassessor, Simbach a/Inn.

Antal, Julius (von), Magistrats-Notar, Central Stadthaus, Budapest.

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Bajard, Jules, Président de la Chambre de Commerce de Roanne.
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Salmoiraghi, Darvino, Ingegnere, piazza Castello, 17, Milano.
Samengo conte **Umberto**, via Sistina, 48, Roma.
San Donnini Pier, Luigi, Presidente del Subcomitato per la Navigazione Interna, Contrada Terraglio Est 4, Modena.
Sanford, Antoinette (Mrs), Philadelphia.
Sanford, Faith, L. (Miss), Philadelphia.
San Juan, Jaub-Manuel (de), Ingénieur au Ministère de la Marine, Bureau des Travaux Hydrauliques, rue Santa Cristina, 22, Rio Janeiro.
Sanjust di Teulada, Maria, nata Manca di Villahermosa, via Aurelio Saffi, 21, Milano.
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Sarrazin, Otto (Frau), Kaiserallee, 117, Friedenau (Berlin).
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Schahovskoï prince **Vsevolod**, gentilhomme de la chambre de S. M. l'Empereur de Russie, fonctionnaire pour missions spéciales près S. A. I. le Directeur en chef de l'Administration générale de la marine marchande et des ports de commerce, rue Torgovaïa, 25/34, St. Petersbourg.
Schaller, J., délégué de la Chambre de Commerce de Strasbourg (Alsace).
Schildener, Albert, Königlicher Wasserbauinspector b. d. Oderstrombauverwaltung, Oberpräsidium, Breslau.

Schimmelbuxr, Max, Ingénieur, via del Coroneo N. 3, Triest.
Schimmelpfennig, Max, Ober-Regierungsrat beim Oberpräsidium, Goethestrasse, 41, Breslau.
Schlick, Rudolf (von), K. K. Eisenbahnministerium, Elisabethstrasse, 9, Wien I.
Schliemann, Karl, Regierungsbaumeister, Pillau (Ostpreussen).
Schmidt, Georg, Hafendirector, Ardeystrasse, 69, Dortmund.
Schmidt, Oswald, Oberbaurat u. Vorstand der Wasserbaudirektion, Wintergartenstrassse, 29/I, Dresden-A.
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Schönbach, Pauline (Frau), Director, Karolinenthal, Prag.
Schreckenthal, Paul, Dr. k. k. Ministerial-Concipist, Handelsministerium, Wien I.
Schuemann (Frau), Regierungsrat, Brandenburgischerstrasse, 15A, Südende bei/Berlin.
Schuk, Franz, k. k. Baurat, Leiter der Expositur der k. k. Direction f. d. Bau der Wasserstrassen, Plassgasse, 616, Prag. III.
Schulte, August, Ernest, Königl. Oberlehrer, 1 II C., Frankfurt (Oder).
Schulz, Wilhelm, August, Emil, Dr. med. Diriz. Arzt d. ev. Krankenhause, Delle, 49, Mülheim-Ruhr.
Schulze, F. W., Otto, Professor an der Technischen Hochschule in Danzig, Langfuhr bei Danzig, Heiligenbrunner Weg, 22A, Danzig.
Scopinich, Luigi U., Direttore della Società di navig. fluviale, Venezia.
Scotti, ing. **Alessandro**, direttore Società Lombarda di elettricità, rappresentante la Società Lombarda per distribuzione energia elettrica, via Principe Umberto, 17, Milano.
Scuola per gli Ingegneri, Padova.
Segadelli, A., Tenente nel Reggimento Pontieri, Dazio Vecchio, 74, Piacenza.
Segovia, Fernando, Ingegnere civile, Esmeralda, 874, Buenos-Ayres.
Segrè avv. **Samuele**, Presidente della Società Ceramica Richard Ginori, piazza Paolo Ferrari, Milano.
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Siebenschein, Josef, Ingenieur, Stadt- und Kammerrath, Agram.

Silva, Opleo, Ragioniere, via S. Antonio, 21, Milano.

Silvestri comm. **Giovanni**, Rappresentante il Touring Club Italiano, corso Venezia, 16, Milano.

Silvestri, Emilio, Possidente, corso Venezia, 16, Milano.

Silvestri Volpi, Bianca, Maria (Donna), corso Venezia, 16, Milano.

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Simpson, Rupert, Managing Director of the British Dredging Company Limited, Delegate of the British Dredging Company Limited, E. C. Leaden Hall-House, 101, London.

Sindaco, della città di Genova, come Rappresentante Croce e Figari.

Sinzig, August (Frau), Bauinspektor, Elsasserstrasse, 58, Bremen.

Sioli, Legnani (Donna), via Borgonuovo, 24, Milano.

Smulders, Henri, Ingénieur-Constructeur, Haringliet, 60, Rotterdam (Hollande).

Sochor, E. B., Secrétaire au Ministère du Commerce, I Kohlmessergasse, 3, Vienne.

Società Anonima Ferrovie Nord, Milano.

Società degli Ingegneri ed Architetti, Galleria Nazionale, Torino.

Società Italiana Langen & Wolf, Fabrica di Motori a gaz « Otto », via Manzoni, 7, Milano.

Sola conte **Gian, Lodovico**, corso Venezia, 22, Milano.

Soldati, Roberto, Ingegnere, via Ospedale, 24, Torino.

Sommariva, dott. **Bassiano**, Consigliere d'Appello, Fondamenta della Chiesa (Miracoli), 6066A, Venezia.

Soncini, Gino, Ingegnere Municipale di Lodi, Lodi.

Sormani-Moretti conte **Luigi**, Senatore del Regno, R. Prefetto, Treviso.

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Stettin, (Stadtverwaltung).

Stettner, **Carl** (Frau), Mülhausen i/Elsass.

Stettner, **Carl**, Kaiserlicher Baurat, Oranstaden, Mülhausen i/Els.

Stevart, **Armand**, Ingénieur en chef honoraire des chemins de fer de l'Etat Belge, Professeur à l'Université, rue Paradis, Liége (Belgique).

Stinnes, **Leo** (Frau), Bergwerkbesitzer, Mannheim (villa Stinnes).

Stobart, **Henry John**, **Scott**, Managing Director, Lighthouse Works, near Birmingham (England).

Stober Rudolf, Gr. Regierungsbaumeister, Hildastrasse, 44, Offenburg i/Baden.

Stoutz, **Henri** (**de**), dott., Carl Heinestr., 10, Leipzig, Plagwitz.

Strade Ferrate Meridionali, Esercizio Rete Adriatica, Direzione lavori, Ancona.

Straschnov, **Hugo**, behördl. autor. Bauingenieur, Oberingenieur der Donauregulirungs-Unternehmung, Garnison Gasse, 3, Wien IX.

Sukihico, **Niwa C. E.**, Engineer in charge, Custom Maritime Work, Yokohama.

Suling, **Eduard**, Baurat, Bremen (Freihafen).

Suardi, **Emanuele**, proprietario dell'Hôtel Cavour, piazza Cavour, Milano.

Sykes, **Robert**, Engineer.

Taako, **Georg**, Civilingenieur, am Wall, 134, Bremen.

Tahy (**von**) **Tahvàr** und **Tarkeö**, Dr. Ministerial-Secretär, Kön. ung. Ackerbau-Ministerium, Budapest.

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Tchai Tchingsoung, Représentant du Gouvernement chinois, Secrétaire de la Légation Impériale de Chine, via Gaeta, 9, Roma.
Tchekhovitch, Paul, Ingénieur, Directeur des travaux maritimes du port d'Odessa et du Danube, Professeur à l'Ecole polytechnique, Odessa.
Tchekhvitch, Sophie (M^me^), Odessa.
Techel, Hans, Schiffbauingenieur, Neumühlen bei/Kiel.
Terruggia, Cav., **Annibale**, Ingegnere, via XX Settembre, 24, Milano.
Teubergen, Sigismund, Rechtsanwalt, Harmoniestrasse, Ruhrort.
Thielecke (Frau), Langegasse, 17, Breslau.
Thiollière, Antoine, Elève Ingénieur des Ponts et Chaussées, Le Havre.
Thoux, Léonie, (M^lle^), Faubourg Saint-Jean, 35, Nancy.
Thoux, Gabrielle-Catherine (M^me^), Faubourg Saint-Jean, 35, Nancy.
Timonoff, Hélène (de) (M^lle^), Perspective Zabalkaneni, 9, Saint-Pétersbourg.
Tolman, Bretislao, D^r^ techn. Ingenieur bei der Kommission für die Kanalisierung des Moldau und Elbeflusses in Böhmen, Karolinenthal, 145, Prag (Böhmen).
Tommasini, Ugo, Ingegnere, piazza Capranica, 95, Roma.
Tortarolo, Lorenzo, Ingegnere del Genio Civile, Padova.
Tosco, Epifanio, Ingegnere Genio Civile, Bergamo.
Trompeo avv. **Eugenio**, Largo dell'Impresa, 123, Roma.
Trabattoni, Giuseppe, Ingegnere, via Borgonuovo, 10.
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Traverso, Giacomo, Ingegnere, via S. Nazzaro, 17, Genova.
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Turrini rag. **Gino**, corso Magenta, 54, Milano.
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Tyszka, Grestaw, Ingénieur des voies de communication, Ptock.

Uhlenbroek, Gysbert, Diederik, Ingénieur, Bloemendal, Schoollaan (Pays-Bas).
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Vaillant, Alexandre, Marie de Santeuil, Délégué de la Société de transports « L'Union Normande », Conflans-Sainte-Honorine (Seine-et-Oise).
Vaillant, Alexandre (M^me^), Conflans-Sainte-Honorine (Seine-et-Oise).
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Valente cav. **Pantaleo**, Ingegnere Capo del Genio Civile, Genova.
Vandenhoute, Ligue de l'Industrie du Bâtiment et des Travaux publics, Jette-Saint-Pierre (Bruxelles).
Vandenperre, Léon (M^me^), Château du Merlo, Forest par Bruxelles
Vandenperre, Violette (M^lle^), Château du Merlo, Forest par Bruxelles.
Van der Sleyden, Emile, Laan Copes 9, La Haye.
Van Haute, Gustave, Ingénieur principal des Ponts et Chaussées, délégué du Gouvernement belge, place du Casino 20, Gand (Belgique).
Van Haute, Marie (M^me^), place du Casino, 20, Gand.
Van Ophem (M^me^), « La Louve », Grand'Place, 5, Bruxelles.
Vassilief, Nicolas, Ingénieur des Ponts et Chaussées, Kronverksky Perspect, 79, St-Petersbourg.
Verdinois, Beatrice (M^me^), Palermo.
Verdinois, Cesare, Ingegnere del Genio Civile, Palermo.

Vernon-Harcourt, Alice (M^me^), Haddon House, Weybridge-Surrey.

Vernon-Harcourt, Mollie (Miss), Haddon House, Weibridge-Surrey.

Verraert, Auguste, Ingénieur, délégué de la Ville d'Ostende, 20, rue de Berlin, Ostende (Belgique).

Vétillart, Henri, Ingénieur en chef des Ponts et Chaussées, rue Brémontier, 14, Paris.

Vicarj, Mario, Ingegnere, corso Vittoro Emanuele, 68, Torino.

Vidal, Paul, Ingénieur en chef des Ponts et Chaussées, 8, rue J.-J. Bel, Bordeaux,

Villa cav. uff. **Libero Renato**, capo-sezione nel Ministero delle Finanze, Roma.

Villa, Giulio, ingegnere, via Durini, 14, Milano.

Vinca, Antonia, Ingegnere piazza S. Giulia, 11, Torino.

Visconti-Venosta ing. **Cesare**, via Boccaccio, 34, Milano.

Vitta cav. **Edoardo**, Ingegnere, viale Principessa Margherita, 17, Firenze.

Volpi Bassano, Sandro, Industriale, rappresentante la ditta A. Volpi e C.,corso Venezia, 16, Milano.

Volpi Ghirardini ing. **Giulio**, Rapp. Collegio degli Ingegneri ed Architetti, Mantova.

Vrbka, Zdenko, referente ferroviario e marittimo della Camera di Commercio ed Industria, Camera di Commercio, Trieste.

Watson, Geneviève (Lady), Victoria Street, 47, London S.W.

Wattenberg, Ernst, Regierungsbaumeister, Kaiserstrasse 66, Essen.

Wauters, Charles, Ingénieur civil, Directeur du Département des Travaux Publics de Tucuman, Mendoza 558, Tucuman (République Argentine).

Weber (Frau), Director der Hannoverschen Bank, Harburg.

Weber, Johann, Eugen, kgl. Kommerzienrat, Sanderring, Würsburg.

Weill, Robert, Dr. k. k. Gericht sekretär im k. k. Handelsministerium, Wallfischgasse, 8, Wien I.

Weithner, Carlo, in rappresentanza delle k. k. Oesterreichische Staatsbahnen, Trieste.

Wendelstadt, Victor, Berthastrasse, 13, Grunewald b/Berlin.

Wetering, Adrienne (van de), La Haye.

Wetering, Hendrine (van de), La Haye.
Wetering, Jeanne (van de), La Haye.
Wilfan, Josef, k. k. Oberbaurat, délégué du Gouvernement maritime de Triest, k. k. Seebehörde, Triest.
Wilhelm (M^me^), Gap.
Wilhelm, Ivan, Ingénieur des Ponts et Chaussées, Gap (France).
Wulle, Karl, Kasernenstr. 32, Harburg a/E.
Williams, Fréderic, administrateur délégué de la Société Générale de touage et de remorquage, délégué de la Société, rue d'Athènes 19, Paris.

Yarach Federico, Tenente di vascello, segretario della sezione della Lega Navale di Milano.

Zanoni, Gio. Batta, Ingegnere, Direttore generale della Società Veneta Lagunare, rappresentante la predetta Società, Venezia.
Zennaro cav. **Costante**, farmacista, Mestre (prov. di Venezia).

MINUTES OF THE MEETINGS

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MINUTES

of the General Meeting

Minutes of the inaugural meeting held under the auspices of Royalty on September 25 1905, in the Scala at 10 a. m.

Their Masjesties the King and Queen of Italy honoured us by their presence at the inaugural meeting of our Navigation Congress. Their Majesties took their places in the centre of the Hall, attended by their Excellencies the President of the Senate and the President of the Chamber, by delegations from both Houses of Parliament, by the Minister of Foreign Affairs, and by the Minister and Under-Secretary of State for Publics Works.

Senator Colombo and Senator Candiani were seated at the two tables of honour to the right and left of the space reserved for the Court.

The following then took their places at these tables : Messrs Alberto Torri and Guiseppe Rota, Italian delegates to the Permanent International Association.

Mr. Alphonse Debeil, General President of the Permanent International Commission of Navigation Congresses.

Mr. Holle, Under-Secretary of State of Prussian Public Works. President of the German Delegation.

Baron Quinette de Rochemont, Inspecteur général des Ponts et Chaussées, President of the French delegation.

Mr. Charles Raymond, brigadier-general U. S. Army, President of the United States delegation.

Mr. de Timonoff, representing the presidency of the Russian delegation.

Mr. Anton Schromm, President of the Austrian delegation.

Mr. Ph. W. Van der Sleyden, former minister of Waterstaat. President of the Netherlands delegation.

Mr. Bela de Gonda, President of the Hungarian delegation.

Mr. Italo Manganzini, Inspecteur supérieur du Génie Civil, departmental President of the Consultative board of Public Works of Italy, and President of the local technical Committee.

Mr. Jean Ricotti, naval captain, ditto.

Mr. Severinos Casana, engineer senator of the Kingdom of Italy President of the executive committee of Section I.

Mr. Léon Romanin Jacur, engineer, deputy of the Kingdom of Italy, ditto, ditto.

Mr. Ignazio Inglese, Inspecteur supérieur du Génie civil, President of the executive committee of Section II.

Mr. François Giuliani, naval captain in the Italian navy, ditto.

Mr. Piero Piola Daverio, engineer, President of the Executive Commission.

The following were also seated at these tables : The Mayor and Sheriffs of the city of Milan.

Mr. Sanjust di Teulada, General Secretary of the Congress.

Mr. Alexis Dufourny, Ingénieur en chef des ponts et chaussées, General Secretary of the Permanent International Association.

Dr. Leo. Sympher, former General Secretary of the Dusseldorf Congress.

Mr. Georges de Joly, Ingénieur des ponts et chaussées.

Major J. J. Sanford, U. S. Army.

Prince Sanetoron Itchyo, fregate captain, Japan.

Mr. Richard Kuhn K. K.

Mr. H. Wartmann, engineer, Netherlands.

The official delegates of foreign countries and all the delegates of corporate bodies were placed at a stand at the end of the hall.

The Senators and Deputies of the Italian Parliament were on the floor of the Hall next to the stage.

All the members of the Congress occupied the floor of the Hall and the boxes which had been placed at the disposal of the Executive Committee by their owners so that many of the lady members of the Congress were thus able to take their seats in these boxes.

The following speeches were made, with the permission of H. M. the King, in accordance with a programme drawn up beforehand in conjunction with the Permanent International Commission.

The Mayor of Milan made the following address :

Sire ! Regina ! Signori !

Interprete della città di Milano, ho l'onore di ringraziare le Maestà del Re e della Regina per la Loro augusta presenza ; la quale in questi giorni conferma ancora una volta, che l'auspicio di Savoia non manca mai alla grande famiglia italiana, ognora che si tratti di benedira agli slanci del suo cuore o alla fortuna de' suoi intraprendimenti.

E l'espressione dell'animo mio grato si rivolge pure agli insigni rappresentanti del Governo e del Parlamento, nonchè alle Autorità ed agli uomini preclari, che hanno voluto associarsi alle onoranze, colle quali Milano saluta oggi orgogliosa il X. Congresso Internazionale di Navigazione ; si rivolge specialmente con un cordiale benvenuto a tutti gli illustri congressisti stranieri e nazionali, la cui partecipazione a questo solenne ritrovo segnerà un avvenimento memorabile negli annali della scienza e della storia lombarda.

La causa a cui convergono i vostri intendimenti, o Signori, non potrebbe essere nè più interessante, nè più degna di raccomandarsi all'attenzione degli studiosi.

Nell'ora in cui assistiamo attoniti alla fantastica trasformazione recata dalle celeri conquiste del progresso al vivere civile nelle più varie sue manifestazioni ed in tutti gli Stati, nell'ora in cui parrebbe ovunque assicurata la prevalente balìa delle grandi imprese o di troppo esclusivi interessi, voi mirate in particolar modo a rendervi sagaci cooperatori d'un importantissimo fenomeno di ricorrenza storica, che ad altri analoghi si collega, e prelude all'avvento d'una novella era economica, provvidamente informata a criteri intensivi ed a più armoniche finalità.

Ecco infatti, pur imperando il lavoro accentrato nei vasti opifici, rinascere la speranza d'un parziale salutare ritorno all'industria casalinga, grazie al concorzo di nuovi ingegnosi strumenti, assistiti da energia mirabilmente distribuita, volti ad

emancipare e centuplicare l'opera individuale del lavoratore e ad integrarne la nativa maestria.

Ecco risorgere, propizio scudo ai pericoli d'un antagonismo, in apparenza irriducibile, fra capitale e lavoro, le vetuste corporazioni di arti e mestieri nella forma più libera ed evoluta delle associazioni di previdenza, delle cooperative, delle professionali ed altre simili, intese a comporre dissidî o a tutelare legittime particolari ragioni.

Ecco rivivere da una parte, accanto ai rapidi ma troppo pesanti e uniformi convogli ferroviari dei dî nostri, i più agili trasporti delle antecedenti età, temprati alla virtù dell'alato automobilismo ; ed ecco dall'altra, per impulso di questi congressi, vicino alla poderosa navigazione degli oceani, che volete perfezionata nei metodi tecnici e negli obbiettivi commerciali e politici, rifiorire, sulle orme gloriose dell'antico, la navigazione interna, quale correttivo agli effetti d'una pubblica economia troppo estensiva e privilegiata, quale mezzo di redenzione a terre e ad ordini di cittadini finora privi di un tanto beneficio.

Così, o Signori, mercè vostra, Milano per nuove arterie protenderà l'alacre fervore della sua vita verso i fiumi e fino ai porti di Venezia e di Ravenna ; così, mercè vostra, e mercè le promesse vittorie della scienza e dell'arte, si chiederanno dovunque alle acque dei mari e dei continenti nuovi preziosi sussidi per lo sviluppo dei commerci e delle relazioni proficue. E il favorito incremento delle ricchezze, la favorita loro diffusione saranno valido fattore di benessere generale, pegno di concordia fra le regioni di uno stesso Stato, stimolo gagliardo all'elevazione delle classi più umili ; le quali non da utopistici miraggi o da sterili lotte, ma dall'agevolata produzione e dalle più frequenti richieste di lavoro hanno a sperare vera salute. E i popoli tutti, educati alla scuola delle opere feconde, anzichè i vani e cruenti allori della guerra aspetteranno dalla sapienza dei reggitori un congruo presidio pel compimento dei loro destini e pel trionfo dei rispettivi e reciproci intenti d'umana cooperazione.

Così, o Signori, l'iniziativa vostra geniale si risente della legge di progresso, che regge tutti i fenomeni della natura, onde accade che i misteriosi disegni del futuro si foggino in parte alla stregua e alla luce del passato ; e nella vostra iniziativa si elaborano i germi d'un mondo, che si fa migliore, si abbellisce e si rinnova.

Epperò in nome di Milano operosa e ben consapevole dell'onore che in questo giorno le tocca, auguro ai vostri lavori un successo degno dei comuni ideali, della somma competenza che vi distingue, delle nazioni gloriose che rappresentate, e dell'alta simpatia, che, con tutta Italia, oggi vi attestano gli amati nostri Sovrani.

Mr. Debeil, president of the International Association, then spoke :

Majesté, Gracieuse Reine,
Excellences,
Mesdames, Messieurs,

L'Association Internationale Permanente des Congrès de Navigation, au nom de laquelle j'ai l'honneur de prendre la parole en cette mémorable réunion, a comme premier devoir à remplir, celui de payer un tribut d'hommage respectueux, de gratitude et de reconnaissance à Sa Majesté le Roi d'Italie, qui a daigné honorer de sa présence cette solennité et attester ainsi le haut intérêt qu'Elle porte à notre Association, à ses travaux et aux questions si vitales qui touchent à la navigation.

Elle présente aussi ses plus respectueux hommages à la Gracieuse Souveraine qui vient rehausser de sa présence cette auguste cérémonie et lui donner un caractère plus solennel encore.

L'Italie est un pays de navigateurs par excellence, c'est la patrie des Marco Polo, des Colombo, des Amerigo Vespucci, des Leonardo da Vinci ; elle possède, relativement à la superficie de son territoire, une étendue de côtes presque illimitée, des rades, des lacs, des fleuves superbes et des ports maritimes, qui occupent une situation de tout premier ordre dans le trafic mondial.

A toutes les époques de son histoire c'est à la navigation que l'Italie a dû une large part de sa puissance et de sa gloire.

L'Italie, aujourd'hui si prospère, que nous voyons marcher à pas de géant dans la voie de tous les progrès, ne peut manquer de voir sa prospérité et sa richesse s'accroître rapidement encore sous l'égide et sous l'impulsion d'un souverain qui a une si haute compréhension des choses de la mer et des trésors

que la navigation dispense toujours généreusement et avec une inépuisable largesse.

Notre Association fait les vœux les plus sincères et les plus complets pour la prospérité de l'Italie et pour la gloire d'un règne qui s'annonce sous d'aussi brillants auspices.

Elle prend part à tous les succès et à tous les progrès de l'Italie, elle ressent profondément tous les événements qui réjouissent ou affligent ce grand pays.

Aussi tient-elle à déclarer en cette circonstance combien, et jusqu'au fond du cœur, elle a compati au cataclysme qui vient de ravager une partie du royaume et de plonger dans le deuil un grand nombre de familles.

Elle admire le caractère généreux et chevaleresque de sa Majesté le Roi, qui s'est manifesté avec une spontanéité si touchante en faveur des malheureuses victimes, et par une sollicitude si fraternelle et si soutenue, malgré la situation périlleuse inhérente à de pareils événements.

Voulant attester ses sympathies par des faits et bien établir que les tremblements de terre de la Calabre ont eu un retentissement international, la Commission permanente, à l'unanimité de ses suffrages, a décidé de participer au soulagement des malheureuses victimes.

L'Association remercie son Altesse Royale le duc de Gênes d'avoir bien voulu accepter la première Présidence d'honneur du X^{e} Congrès, et lui accorder son haut appui.

Elle remercie enfin leurs Excellences Messieurs les Ministres des Affaires Etrangères et des Travaux publics d'avoir mis leur influence et leur autorité si considérables au service du X^{e} Congrès.

La Commission d'organisation locale de Milan, qui dans quelques instants va, aux termes des statuts de l'Association, présider et diriger cette session a droit aussi à nos remercîments et à tous nos éloges. Elle a admirablement préparé les assises du Congrès ; elle y a apporté un zèle des plus louables, tout son dévouement, tout son amour-propre national ; elle a fourni un travail considérable, créé une organisation qui pourra servir de modèle dans l'avenir.

MM. les Présidents généraux Sénateurs Colombo et Candiani, MM. les Présidents Maganzini et Piola Daverio, M. le Secrétaire Général Sanjust di Teulada et leurs collaborateurs si dévoués,

si intelligents et si actifs, méritent d'avoir leurs noms inscrits dans les annales de notre Association.

Grâce au concours si précieux, auquel je viens de rendre hommage, grâce à la Commission Internationale permanente des Congrès et aux chefs de délégations des Gouvernements, qui, toujours avec le plus grand empressement, nous ont en toutes circonstances apporté leur concours entier confraternel et dévoué, grâce au Secrétaire Général de notre Association, M. l'Ingénieur en chef Directeur Dufourny, à sa valeur, à son dévouement et à son travail, grâce enfin à la concorde, à l'entente parfaite qui ont régné sans partage au sein de l'Association, grâce au concours et à la volonté de vous tous qui représentez ici quarante nations réparties sur tous les points du globe, nous avons fondé, j'ose l'espérer et le dire, une œuvre aussi impérissable que l'airain.

Notre Association est l'une des œuvres internationales les plus anciennes et sans doute l'une des plus puissantes qui soit au monde. Elle est forte aujourd'hui de l'appui moral et pécuniaire de trente Gouvernements, de deux cents collectivités et de près de quinze cents membres. Il ne dépend que de vous, Messieurs, de voir notre Association doubler de puissance, dans le cours de cette année encore, en lui apportant le concours des grandes cités maritimes, des Chambres de commerce et des sociétés de navigation si puissantes et si nombreuses par toute la terre. Les pouvoirs publics ont agi, c'est l'initiative privée qui doit compléter notre œuvre.

Cette œuvre est toute de paix et de travail. C'est l'avoir technique et scientifique de toutes les nations de la terre mis en commun pour donner à la navigation son plus grand essor et pour contribuer le plus largement possible au profit de l'humanité.

Nous sommes tous ici des hommes de paix et des travailleurs dont le seul souci, le seul but et la seule raison d'être est de construire, d'édifier, de créer des voies de communication, des relations nouvelles, de rapprocher, d'unir les peuples, de supprimer les distances, de permettre aux hommes de se connaître, de s'apprécier, de s'entr'aider et d'échanger leurs idées et leurs produits pour accroître le bien-être général.

Notre Œuvre internationale a réalisé déjà des résultats considérables et nous les avons fait connaître en publiant le Catalogue de nos travaux.

Ce sera l'éternelle gloire des ingénieurs et des navigateurs d'avoir créé cette institution mondiale, d'avoir donné l'exemple, l'impulsion, et d'avoir tracé la voie à suivre désormais dans toutes les sphères de l'activité humaine.

Ce sera l'honneur de l'Italie, de son Auguste Souverain, de son Gouvernement éclairé, et de tous les hommes d'élite qui ont coopéré à la réunion du X^e^ Congrès d'avoir tenu tous les premières assises de notre Association Internationale.

C'est d'Italie que, depuis le commencement de notre ère, l'on a vu partir la lumière, la civilisation et les progrès de la navigation ; c'est d'Italie aujourd'hui encore, et c'est justice, que vont partir bientôt et se répandre dans le monde les résultats des travaux du X^e^ Congrès de Navigation.

Aussi, Messieurs, je confonds en ce moment dans mon esprit l'Italie et notre œuvre internationale, l'Italie qui va servir de marraine à celle-ci et lui donner, dans cette superbe ville de Milan, un baptême non moins pompeux que solennel.

J'ai dit.

Senator Colombo, General President of the Milan Congress, then rose and spoke as follows :

Maestà, *Graziosa Regina*,
Signori e Signore,

L'Associazione internazionale permanente dei Congressi di Navigazione risiedente a Bruxelles, che fu costituita nell'ultimo Congresso tenuto a Düsseldorf nel 1902 collo scopo di promuovere questi periodici convegni dell'Associazione e dare l'indirizzo più opportuno alla loro produzione scientifica, ha accettato l'offerta del governo italiano che il X. Congresso fosse riunito quest'anno a Milano. E poichè il Governo ha voluto affidare all'Onorevole Senatore Conte Candiani di Oliva e a me l'incarico di presiedere la Commissione di organizzazione del Congresso, così è anche a nome suo e in rappresentanza della Commissione d'organizzazione che io ho oggi l'onore di parlare in questa adunanza, colla quale il Congresso inizia la serie delle sue sedute.

Voi vi siete degnato, o Sire, di accogliere benevolmente la nostra preghiera di solennizzare colla vostra augusta presenza

la prima riunione di tanti eminenti cultori della scienza e dell'arte dell'ingegneria, i quali si son dato quì convegno da tutte le parti del mondo per risolvere problemi che interessano le più fecondo sorgenti della prosperità delle nazioni. Essi andranno superbi che Voi inauguriate i loro lavori.

Appena reduce da quella forte Calabria che un'immane sciagura ha gettato nella desolazione e nel lutto, dove i nostri fratelli, vittime a migliaia delle cieche e sorde forze della natura, si sono affollati dietro ai vostri passi benedicendo al vostro nome, Voi non avete voluto mancare a questo convegno scientifico, pronto come siete stato sempre, a vivere la vita del popolo vostro, nel dolore come nella gioia, nella sventura come nella fortuna, nelle manifestazioni dell'arte come in quelle della scienza. Noi ve ne siamo, o Sire, profondamente grati, lieti di potere presentare in questa solenne occasione il nostro riverente omaggio a Voi e alla Vostra augusta Consorte, ispiratrice e collaboratrice gentile di ogni nobile iniziativa.

A Voi, Sire, che seguite con cosi vivo interesse tutti i progressi scientifici e sapete apprezzare la grandezza dei benefici che essi apportano all'umanità, non poteva sfuggire l'importanza dell'odierno convegno, tanto nell'interesse generale dell'industria dei trasporti di tutto il mondo, quanto e in ispecial modo in quello della prosperità avvenire del nostro paese.

È per questo che gli spiriti si sono sempre più impressionati dai risultati dei Congressi che del 1885 in poi si sono succeduti prima a Bruxelles, poi a Vienne, a Francoforte, a Manchester, a Parigi, all'Aja, poi ancora a Bruxelles e a Parigi e infine a Düsseldorf : congressi limitati dapprima alle sole questioni interessanti la navigazione interna, poi estesi anche alla navigazione marittima. La molteplicità dei problemi che vennero mano mano sorgendo in ambo gli ordini di questioni, la fortuna colla quale vennero mano mano risolti e la grandiosità dei risultati ottenuti hanno ben presto additato l'opportunità di dare un assetto e un ordinamento definitivo all'istituto dei Congressi di navigazione e di imprimere loro un forte carattere internazionale col contributo materiale e morale dei Governi e delle associazioni scientifiche. La compartecipazione di trentasei Stati di Europa, d'Asia e d'America, egualmente interessati al successo dell'Associazione, e il concorso di congressisti che oggi si affolano in quest'aula, sono la prova più evidente dell'importanza che oggi si attribuisce nel mondo scientifico e tecnico a questi periodici ritrovi ; e Milano,

la cui fortunata posizione nella valle del Po, come punto d'incrocio delle grandi vie di comunicazione fra l'Europa occidentale e centrale e il Mediterraneo, ha contribuito a designare come sede del X. Congresso, è ben lieta e orgogliosa di poterlo ospitare.

Collo sviluppo enorme che la marina mercantile e militare ha preso in tutti i paesi che trovansi a contatto col mare, le questioni che si riferiscono alla navigazione marittima, che è una delle due Sezioni nelle quali si suddivide il Congresso, vanno assumendo un'importanza sempre più grande e multiforme. Ben lo sa l'Italia, le cui terre si protendono per così lunga tratta frammezzo a due mari.Le difese dei porti, la facilità degli approdi, l'installazione dei fari, i congegni pel carico e scarico delle merci, le comunicazioni ferroviarie fra l'interno e il mare, i sistemi di costruzione delle navi, i loro meccanismi motori, il loro addobbo, i loro mezzi di rifornimento, costituiscono altrettante questioni che interessano sommamente le nostre industrie marinare, come quelle di tutto il mondo. È quì che nelle discussioni fra i più competenti, e nelle deliberazioni cui daranno luogo, i commercianti, i navigatori e gli ingegneri navali attingeranno preziosi insegnamenti.

Benchè l'Italia colle potenti flotte di Venezia, di Genova e di Pisa sia stata in altri tempi dominatrice e maestra sui mari, pure deve ora ispirarsi ai procedimenti seguiti dalle nazioni che l'hanno superata nel dominio del mare, allo scopo di riconquistare l'antica floridezza delle sue flotte e dei suoi commerci. Ora questi periodici ritrovi servono appunto a far diventare patrimonio comune di tutte le nazioni l'esperienza di ognuna ; i metodi riconosciuti imperfetti sono definitivamente scartati, quelli riconosciuti migliori ricevono la loro definitiva sanzione. La scienza fortunatamente non ammette frontiere, non conosce rivalità nè gelosie di nazionalità e di razze.

Altrettanto importanti appaiono le questioni connesse coll'altra Sezione della navigazione interna, più importanti anzi perchè si tratta di un campo sul quale solo da non lungo tempo si è rivolta la pubblica attenzione. Lo sviluppo incredibilmente rapido che hanno preso le ferrovie in poco più di mezzo secolo hanno fatto relegare per qualche tempo in seconda linea la questione delle comunicazioni per acqua nell'interno dei continenti. Ma l'aumento degli scambi e il costo elevato dei trasporti per terra delle merci più voluminose e di minor valore

hanno rimesso in onore le umili vie dei fiumi e dei canali, prima eclissate dalla propotente vaporiera.

In Italia la navigazione interna ha avuto, è vero, i suoi più grandi trionfi, quando nel resto del mondo era negletta o affatto sconosciuta. I nostri antichi *navigli* lombardi, quei canali sapientemente costrutti per collegare il Ticino e l'Adda a Milano e alla grande arteria del Po, rimangono ancora come monumenti imperituri della scienza idraulica italiana, che brillò come faro quando altrove si vagava ancora nell'oscurità ; e voi, Signori Congressisti, avrete fra qualche giorno l'occasione di constatarlo, ammirando nella gita a Paderno i celebri sostegni che il genio di Leonardo ideò cinque secoli or sono. Ma nei tempi moderni altre nazioni ci hanno sorpassato coll'apertura di nuove e numerose vie destinate a offrire alle merci povere e voluminose un mezzo di trasporto più economico della ferrovia. L'Olanda colla sua lotta ostinata contro le invasioni del mare et la sua rete meravigliosa di canali ; la Germania che spinge le sue imbarcazioni da commercio sempre più avanti sul Reno, prima à Mannheim, poi a Strasburgo, poi a Basilea, facendo concorrenza sul Lago di Lucerna ai cereali provenienti dal nostro porto di Genova ; la Francia che attende senza posa a rendere navigabili i suoi grandi fiumi e che estende colla navigazione sul Rodano il raggio d'azione del porto di Marsiglia ; l'Austria che perfeziona sempre più la grande arteria commerciale del Danubio ; il Belgio che sta creando a Bruxelles una stazione marittima aperta alle grosse navi da carico, quasi una succursale al suo grande porto di Anversa ; altre nazioni presso le quali la navigazione interna sta pure facendo sorprendenti progressi, ci vanno continuamente additando la via per trarre maggior partito dalle nostre arterie fluviali e sopratutto del Po e dei suoi affluenti nella grande ed ubertosa valle che racchiude il settentrione d'Italia. Questi insegnamenti che ci vengono dai paesi rappresentanti all'odierno Congresso, i risultati delle proposte e delle discussioni che si svolgeranno durante le sedute per opera degli uomini più competenti nell'arte dell'ingegneria, non devono essere perduti per noi. Già la spinta a questi studii è stata data in Italia da statisti e da ingegneri eminenti. Voi vedrete esposti nelle sale del Congresso i progretti per rendere Roma un porto di mare ; voi vi troverete una serie di mirabili sudii sul Po e dei progetti completi per allaciare con una via d'acqua ininterrotta Venezia a Milano. Questo allacciamento è sempre stato l'obbiettivo

desiderato, il punto di mira di quasi un secolo di ricerche e di tentativi. L'impresa di rimontare il Po è stata più volte tentata e abbandonata, ma ora grazie agli studii e alle iniziative recenti, il grande problema può dirsi alla vigilia di essere risolto, solo che alla sapiente preparazione degli studii statistici e tecnici faccia immediato seguito la feconda azione del capitale, e il Governo del paese si convinca che si tratta di un grande interesse nazionale pel quale è richiesto il suo più largo e più sollecito intervento.

Voi vedete adunque, o Sire, quale somma di interessi scientifici e commerciali, quali vasti problemi, quante ardenti e legittime aspettative racchiudano nel loro seno le discussioni di questo Congresso che Voi state per inaugurare.

Ma lo spirito scientifico è incontentabile a va senza posa alla ricerca di nuovi e sempre più estesi e più lontani orizzonti. Altri arditissimi problemi saranno probabilmente toccati, se non risolti, nel presente Congresso ; problemi che fanno intravedere come non affatto impossibile un avvenire ben lusinghiero pel nostro paese. L'Italia è separata in tutta la sua lunghezza da un'alta barriera, la catena debli Appennini, che ostacola le comunicazioni fra i porti del Mediterraneo e quelli del mare Adriatico. Una barriera ancora più alta, quella delle Alpi, ci divide dal resto dell'Europa. Le strade ferrate hanno faticosamente superato quest'ostacolo formidabile, al Cenisio dapprima, poi al Brennero, alla Pontebba e al Gottardo, ed ora lo valicheranno al Sempione, ma l'ostacolo è troppo elevato perchè i nostri maggiori porti settentrionali, Genova e Venezia, possano lottare con vantaggio coi porti dei mari del Nord, le cui vie di penetrazione sono rese più facili ed economiche utilizzando le arterie fluviali. Fu già un'antica idea l'allaciamento di Genova e di Venezia con un canale attraversante l'Appennino ; nessuno l'ha raccolta sinora, benchè molti la coltivino ancora nel segreto della loro mente. Ma sarebbe egli possibile di attraversare con un canale le Alpi e portare le provenienze dei paesi mediterranei e dell'oriente sui mercati dell'Europa centrale a condizioni pari a quelle alle quali vi penetrano le provenienze dai porti del Nord ? Per quanto audace, questa possibilità fu pure oggetto di discussione, e voi ne udrete probabilmente l'eco nelle prossime sedute del Congresso.

Non si tratta di sogni di menti inferme, nè di vane e insensate fantasie. Tali apparvero una volta la navigazione a vapore,

le gallerie ferroviarie correnti per decine di chilometri nelle viscere delle montagne, il traforo dell'istmo di Suez ; eppure questi, che erano reputati sogni, son diventati realtà. Non si è potuto ancora segnare un limite alle audacie della Scienza e dell'attività umana ; e sarebbe assai malavvisato colui che pretendesse di negare senza conoscerli i segreti nascoti nelle pieghe dell'avvenire. Ma se l'attraversamento delle Alpi con un canale non apparisse nè impossibile nè indefinitamente lontano, non è egli vero che l'Italia, gettata, come è, sul Mediterraneo a guisa di una grande banchina rivolta verso l'Oriente, potrebbe diventare davvero la gran via Internazionale fra l'Oriente e il cuore dell'Europa, e che i nostri porti dell'Adriatico e del Mediterraneo diventerebbero i porti di approvvigionamento di un vasto *hinterland* al di là delle Alpi ?

Non respingiamo da noi, pel timore di illuderci, queste seducenti visioni. La scienza ha anch'essa la sua poesia ; e l'immaginazione ha nel segreto e misterioso processo col quale si svolgono nella mente dello scienziato le più geniali invenzioni, una parte assai maggiore di quella che volgarmente si crede. Manteniamo adunque intera la nostra fiducia nel potere della scienza e accompagniamo colla nostra simpatia e coi nostri voti questi uomini valorosi, i quali senza preoccuparsi di interessi materiali e ispirandosi soltanto al più puro amore del progresso sono qui convenuti per far procedere l'umanità sempre più avanti verso i loro alti ideali.

E bene auguriamo ai loro lavori al grido che tutti ci unisce : Viva il Re.

His Excellency, Mr. Ferrari, Minister of the Public Works then expressed himself in the following terms :

Sire,
Graziosa Regina,
Signore e Signori,

Sono trascorsi appena nove lustri da che per l'opera forte e sapiente del grande avo, di cui la Maestà Vostra porta si degnamente il nome, la patria ha conseguita indipendenza ed unità : nove lustri, lungo spazio di tempo per la vita di un individuo, ma brevissimo per quella di un popolo.

E così i ponderosi problemi che altri Stati poterono affrontare e risolvere con lunga preparazione e successivamente, da noi dovettero essere affrontati e risolti con somma rapidità e contemporaneamente ; creazione del sentimento politico unitario in un paese diviso da secoli, formazione di un esercito nazionale e di un sistema finanziario ed amministrativo rispondente alle nuove condizioni nazionali e sociali, rinnovamento degli istituti scolastici, agricoli, commerciali, costruzione di reti stradali, ferroviarie, postali, telegrafiche, che congiungessero ogni parte del nuovo Regno, miglioramento edilizio ed igienico delle grandi città e via dicendo, mentre si dovevano risvegliare e secondare le sopite energie individuali che così poterono espandersi et mostrare, in ogni ordine di attività umana, che (mi sia concesso di esprimermi volgendo ad altro significato le parole di un sommo poeta) l'antico valore non era morto nei cuori italici. E purtroppo si dovette anche lottare contro la natura, così bella, ma talora così matrigna che non ci risparmiò le sue insidie e le sue percosse.

Ho voluto ricordare questi eventi specialmente affinchè gli illustri stranieri, che onorano colla loro presenza questa adunanza, conoscano la ragione per la quale ad alcuni problemi, alla cui soluzione essi intendono con tanta dottrina e tanto ingegno, non si è ancora potuto nel nostro paese provvedere in tutto colla larghezza di mezzi e potenza di esecuzione richiesto dall'odierno progresso.

Primo fra essi il problema della navigazione interna. È omai inutile ripeterlo : a cominciare dal dodicesimo, fu per parecchi secoli l'Italia l'audace precorritrice nel regolare i fiumi e costruire i nuovi canali a scopo di navigazione, e gli annali dell'Achitettura idraulica unanimi attribuiscono ad Italiani le innovazioni fondamentali per vincere gli ostacoli derivanti dalle differenze di livello. Così si formò gradatamente quella fita rete di vie navigabili interne, la quale, vigilata con sollecita cura dai governi, tanto contribuì ad agevolare il movimento delle persone e gli scambi delle merci fra le città dell'alta Italia nel periode perennemente memorabile del Rinascimento. Nè mancarono opere importanti anche nei secoli succesivi e fino a questi ultimi tempi, se anche, piuttosto che alla navigazione interna, siasi pensato alla irrigazione, alla derivazione d'acqua per forza motrice e alle bonifiche. Ne è a dimenticarsi, per giustificare la scemata operosità, che darebbe luogo a facile e non meritata

critica, il rapido sviluppo delle strade ferrate, il quale per lungo tempo e non soltanto presso di noi fece credere quasi inutile il pensare omai alla navigazione interna considerata come mezzo affato secondario di scambio e non meritevole che i capitali si distogliessero per essa da più proficui impieghi.

Fortunatamente da alcuni anni il pregiudizio è dissipato e si cerca ora di guadagnare rapidamente il tempo perduto.

E mi sia quì concesso di mettere in evidenza l'opera del Ministero che in questo momento ho l'onore di reggere. Una prima Commissione che in esso ebbe sede, ha compiuto nel 1903, in nove volumi, un mirabile studio sulla navigazione interna nella Valle del Po da Venezia a Milano. Una seconda commissione costituita nell'ottobre di detto anno ebbe l'incarico di studiare il problema della navigazione interna per tutto lo Stato : e quella parte della Commissione, che ebbe il titolo di Comitato Tecnico Esecutivo, può presentare a questo Congresso in cinque volumi lo studio completo nell'ordine tecnico sulla navigazione del Po da Torino all'Adriatico et sulla rete di navigazione che al grande fiume si connette, studio compiuto dai valorosi membri del Comitato, efficacemente coadiuvati da valenti tecnici governativi e delle provincie e città piemontesi più direttamente interessate. E già un'altra parte della Commissione sta raccogliendo i dati per lumeggiare il problema dall'aspetto economico.

Una diligente monografia compilata da egregi funzionari del Genio civile, presenta un completo ragguaglio della storia della navigazione interna italiana, dello stato attuale dei laghi, fiumi e canali navigabili, di tutti i progetti tecnici già compiuti per iniziativa del Governo o privata, accennando pure ai provvedimenti necessari.

Il volume è offerto al Congresso e le sue opportune illustrazioni permetteranno di avere anche un'immagine delle bellezze che si dischiudono allo sguardo percorrendo quelle vie acquee. E giova sperare che lo sviluppo della navigazione interna consentirà agli stranieri visitatori di abbandonare per qualche tempo nei loro viaggi le polverose strade ordinarie e le fumose e rapide strade ferrate, per contemplare, con occhio più riposato e più tranquillo moto, pianure e colline lussureggianti di vegetazione e biancheggianti ville e ridenti villaggi, portando così nella loro patria più piena e quasi direi più leggiadra impressione del nostro paese.

Compiuti gli studi verrà l'opera pratica, ed anche quì l'Italia apparirà memore del suo passato e rinnovellerà le sue gloriose tradizioni, ma in conformità dei tempi nuovi e coi mezzi poderosi che la tecnica moderna appresta.

E le numerose ed elaborate monografie presentate al Congresso da stranieri e da nazionali ci forniranno insegnamenti preziosi e di esse saprà tenere il debito conto quell'egregio corpo del Genio Civile che nei ricordati studi come in quelli, che ricorderò in appresso, ebbe così larga parte, come ne avranno lume i solerti Comitati locali sorti per iniziativa privata qui e in altre città, e coloro che già con sacrifici personali si accinsero all'azione pratica.Così anche dalla scienza e dall'esperienza delle altre nazioni noi trarremo guida e norma per raggiungere più sicuramente e più celeremente il nostro intento.

Per l'altro ordine di indagini a cui dovrà attendere il Congresso, quello della navigazione marittima, avrei desiderato qui presente il collega che regge il Ministero della Marina. Ma il valoroso marinaro sta per abbandonare un più quieto lavoro per recarsi ad assistere alle manovre navali, nelle quali rifulgerà la virtù di quella flotta che non è soltanto difesa militare ma anche tutela e presidio degl'interessi commerciali.

Egli esprime per mezzo mio il suo dispiacere di non poter assistere ai lavori del Congresso, ove avrebbe ravvivate le memorie del passato, sulle quali un sapiente volume il suo Ministero offre ai convenuti, ed avrebbe espresse le balde speranze dell'avvenire commentando con fervida parola l'audace divisa del Congresso « Navigare necesse ».

Limitandomi quindi al mio più modesto compito mi è grato anche quì additare all'attenzione vostra l'ampia e ben redatta monografia che per opera di egregi ingegneri del Genio Civile il Ministero dei LL. PP. ha pubblicato sui porti marittimi del Regno.

Vi troverete riassunto quanto è stato fatto per il miglioramento dei copiosi ricetti che il lungo sviluppo delle coste italiane offre alle navi, e nel dare giudizio su questi lavori, cui pure intese il corpo del Genio Civile, non bisogna dimenticare che una grave difficoltà a provvedimenti completi derivò dalla molteplicità dei bisogni, cui si trattò di soddisfare, sia per il grande numero dei porti, sia per la crescente dimensione delle navi, sia infine pel rapidissimo incremento del movimento commerciale. Così, mentre si sta preparando da apposita Commissione,

Bridge over the Tessin near Pavia.

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che nello scorso anno ha iniziato le sue fruttuose indagini, un piano generale regolatore dei porti, l'accennato volume vi sarà prova che la nuova Italia non ha trascurati i maggiori sforzi per consentire alla navigazione marittima le agevolezze corrispondenti all'altissimo posto che le spetta nell'economia nazionale.

Ed ora, che si avvicina il momento in cui l'opera feconda del Congresso deve incominciare,in nome del Governo manifesto la soddisfazione che per questa sessione si sia scelta come sede l'Italia e, in Italia, Milano, la città che per la vigorosa iniziativa dei suoi abitanti e delle sue amministrazioni degnamente rivaleggia colle altre grandi città visitate dal Congresso nelle sue peregrinazioni : faccio plauso alle varie Commissioni ordinatrici che con zelo indefesso tutto predisposero per agevolare la venuta ed il lavoro dei numerosi aderenti : offre un caloroso ringraziamento agli stranieri che vennero a portarci il contributo della loro scienza e ad onorarci colla loro presenza e che qui annoderanno o riannoderanno vincoli di amicizia coi nostri che pure saluto, compiacendomi di vederli così numerosi; ed esprimo l'augurio che questa decima sessione consolidi l'Associazione Internazionale Permanente dei Congressi di Navigazione creata nella precedente sessione e ne accresca le già grandissime benemerenze par congiungere le nazioni in una fruttuosa cooperazione e raggiungere più alti destini colla concordia e la pace.

Sire,

Pochi giorni or sono io aveva l'onore di accompagnarvi nella faticosa visita alle squallide rovine dei comuni calabresi ed ho sentito dal labbro vostro l'affettuosa parola di conforto a quelle infelici popolazioni.

Oggi ho l'onore di essere al vostro fianco ad una grande solenità delle scienze teniche et di pregarvi perchè mi concediate di essere l'interprete dell'Augusta parola che inizierà i lavori del Congresso.

Presente ieri sul luogo del dolore, Voi siete, o Sire, presente oggi qui dove la scienza intende a preparare nuovi progressi all'umanità. E Voi sapete, o Sire, che fra i due fatti avvi un intimo legame perchè ogni innovazione procurata dalla scienza

scema od evita qualche sofferenza umana. E così il mondo civile vi vede sempre intento ad accorrere ovunque possiate promuovere il bene e dare nobile esempio ed incitamento alle opere di civiltà.

Per questi gagliardi lavoratori delle scienze tecniche che con tante preziose monografie diedero prova del loro sapere, e che ora sono bramosi di scambiare le loro idee e di discutere il risultato dei loro studi, vi domando, o Sire, l'autorizzazione di dichiarare in nomo vostro aperto il Decimo Congresso Internazionale di Navigazione.

The Minister then declared the Xth International Navigation Congress to be open in the name of H. M. the King; and Senator Colombo, general president of the Congress in accordance with His Majestys instructions requested baron Quinette de Rochemont, French delegate and the senior of the foreign delegates, to address the meeting on behalf of the foreign members.

Baron Quinette de Rochemont thereupon made the following speech in French.

Majestés,

Appelé à l'honneur de prendre la parole au nom des délégués des divers Gouvernements étrangers et des membres du X^{e} Congrès de Navigation, Sa Majesté le Roi me permettra de lui exprimer tout d'abord les sentiments de vive gratitude pour l'honneur qu'Elle nous fait en acceptant de présider la première séance du Congrès. Sa Majesté donne ainsi une nouvelle preuve de l'importance qu'Elle attache aux travaux de nature à rapprocher les Nations et à contribuer ainsi à la paix générale. C'est là une œuvre digne du Souverain qui récemment encore conviait à toutes les Nations à se réunir en Conférence pour examiner la situation de l'Agriculture et les moyens de favoriser son développement.

Sa Majesté La Reine voudra bien agréer nos respectueux hommages. Sa gracieuse présence parmi nous montre une fois de plus l'intérêt qu'elle porte aux travaux de l'intelligence. Nous lui en sommes profondément reconnaissants.

Aussi conserverons-nous un souvenir inoubliable de cette séance où, pour la première fois, le Congrès a le grand honneur d'être ouvert par les Souverains du Pays où il se réunit.

Majestés,
Mesdames, *Messieurs*,

Le mouvement d'opinion qui se produit dans le monde entier en faveur du développement de la Navigation, contribue au succès sans cesse grandissant des Congrès de Navigation.

Le X[e] Congrès compte en ce moment 2,500 adhérents, alors que le IX[e] n'en avait réuni que 2,000 et le VIII[e], 1,300 environ. Le nombre des rapports s'est accru dans les mêmes proportions. Aussi ce Congrès, qui a donné lieu à de nombreux et intéressants mémoires, aura-t-il une influence non moins grande que les précédents pour arriver à solutionner diverses questions depuis trop longtemps en suspens.

Depuis notre dernière réunion à Dusseldorf, en 1902, l'Allemagne et la France ont décidé l'exécution d'importants travaux intéressant la Navigation.

En Allemagne, 280 kilomètres de voies nouvelles vont être ouverts et 655 kilomètres de voies anciennes améliorés, moyennant un dépense de 582 millions de francs. Un canal sera établi pour relier le Rhin au Weser ; seront améliorés l'Oder, le Havel, la Sprée, la Neisse, la ligne de Berlin à Stettin, ainsi que diverses autres rivières dont l'énumération complète serait trop longue.

En France, on a commencé l'exécution du programme ayant fait l'objet de la Loi du 22 décembre 1903. Une somme totale de 257 millions doit être dépensée, dont 170 millions pour l'amélioration de la navigation intérieure et 87 millions pour celle des dix principaux ports maritimes.

Les voies navigables du Nord et de quelques autres régions seront perfectionnées ; de nouveaux canaux relieront,d'une part, les houillères du Nord à Paris et, d'autre part, Marseille et Cette au Rhône ; le canal sera prolongé.

Durant ces trois années, presque tous les ports maritimes ont été agrandis et aménagés dans le but de recevoir des navires dont les dimensions vont toujours en augmentant. L'on voit déjà sur mer des bâtiments ayant 215 mètres de long, 21 m. 30 de large et plus de 9 mètres de tirant d'eau ; ces dimensions, qu'à une époque peu éloignée, l'on considérait comme n'étant pas réalisables, ne tarderont pas à être dépassées, et l'on prévoit, pour un avenir relativement prochain, des navires de 300 mètres

de longueur, de 30 mètres de largeur, ayant plus de 10 m. 50 de tirant d'eau.

Dès à présent, le mouillage de 9 mètres se trouve réalisé à basse mer dans 70 ports et à haute mer dans 113.

La profondeur dans les chenaux, ainsi que dans les fleuves donnant accès aux ports maritimes, est accrue principalement au moyen de dragages et parfois par des travaux de régularisation. Les augmentations de profondeur atteignent souvent de 2 à 3 mètres et quelquefois davantage.

Des ports nouveaux sont en voie d'achèvement à Douvres et à Zeebrugge.

L'outillage des ports maritimes a été grandement amélioré. Les méthodes d'exploitation et d'administration ont fait l'objet d'études, dont nous trouvons l'écho dans des rapports qui nous sont soumis. L'Italie est rentrée dans une voie nouvelle sur le Continent en organisant le Consortium autonome qui administre le port de Gênes.

L'amélioration des canaux maritimes et le développement de leurs installations se poursuivent dans divers Pays. Le Gouvernement des Etats-Unis a repris les travaux du canal de Panama avec l'intention de les achever dans le plus bref délai possible.

La régularisation de diverses rivières et leur appropriation à la navigation sont en cours ; il en est ainsi, notamment, pour le Rhin supérieur, le Danube, la Moldau, la Loire, le Volga et quelques rivières de la Hongrie.

L'amélioration des canaux existants donne lieu à des entreprises importantes dans presque tous les Pays et particulièrement en Belgique et aux Etats-Unis, où l'on transforme le canal Erié. En Autriche, l'on a préludé à la création du réseau de voies navigables, faisant l'objet de la loi du 11 juin 1901, par l'ouverture d'un concours pour l'étude d'un appareil susceptible de faire franchir aux bateaux les grandes chutes en une seule fois.

Les travaux de navigation intérieure sont maintenant disposés en vue de satisfaire autant que possible aux besoins de l'Agriculture et à la production de l'énergie électrique. L'Allemagne, la France, l'Italie et les Indes occidentales sont entrées dans cette voie.

La traction électrique, qui n'a guère été employée jusqu'à présent qu'à titre d'expérience sur les voies navigables d'Allemagne, de Belgique et de France, tend à se généraliser ; les

discussions qui ont eu lieu dans divers congrès et celles qui vont s'ouvrir dans notre session actuelle, ont certainement contribué à favoriser ce développement.

La sécurité de la navigation maritime a été grandement accrue par l'établissement de feux éclairs et de feux permanents, par l'emploi de nouvelles sources lumineuses, incandescence par la vapeur de pétrole comprimé et l'acétylène, et par la création d'un nouveau type de feu flottant. La France a eu une part prépondérante dans ces innovations. Les bouées lumineuses sont de plus en plus fréquemment employées. L'Allemagne, l'Angleterre et les Etats-Unis se servent de la télégraphie sans fil pour communiquer avec leurs feux flottants.

En dernier lieu, les Etats-Unis, la France, l'Italie et la Russie se préoccupent de modifier leur législation pour venir en aide à leur marine marchande.

Mais ces travaux, quelques considérables qu'ils soient, ne suffiront pas pour satisfaire aux besoins toujours croissants de la Navigation. Aussi tous les Pays étudient-ils de nouveaux projets, dont beaucoup paraissent devoir être réalisés dans un délai relativement court. Parmi les plus importants de ceux-ci, indépendamment des travaux dans les ports maritimes qui ne cesseront pas de se poursuivre presque partout, l'on peut citer la rectification de l'Escaut aux abords d'Anvers et la création d'une voie reliant la Baltique et la mer Caspienne.

L'Italie, dont le rôle dans le monde a toujours été si considérable, n'est pas seulement la patrie des Arts ; elle a toujours tenu et elle tient plus encore maintenant une place importante dans le Commerce et la Navigation. Aussi est-elle sur le point d'adopter un programme comprenant l'amélioration d'un grand nombre de ses ports maritimes et la rénovation de son système de voies navigables intérieures.

L'Italie est justement fière de la part qu'elle a prise au développement de la Navigation. Elle n'oublie pas que c'est à peu de distance de Milan qu'en 1429, l'illustre Léonard de Vinci a inventé l'écluse à sas, et que peu après, au XVI[e] siècle, le premier plan incliné pour bateaux a été construit.

Enfin c'est l'un de ses plus glorieux enfants, Christophe Colomb, qui le premier a traversé l'Atlantique pour atteindre les Antilles et découvrir ainsi l'Amérique.

Aussi est-ce à juste titre que les organisateurs du X[e] Congrès ont voulu rappeler ces deux événements mémorables qui ont

révolutionné le monde, en faisant frapper la médaille qui nous a été remise comme signe de ralliement. Cette délicate attention ajoute à la reconnaissance que nous leur devons pour la préparation si remarquable à tous égards du Congrès. Nous le déclarons hautement en leur adressant, avec nos remerciements, nos biens sincères félicitations pour la manière brillante dont ils ont rempli la tâche ardue qui leur incombait.

Au nom des Délégués des Gouvernements étrangers, et de tous les membres du X^e^ Congrès de Navigation, je remercie également chaleureusement son Excellence le Ministre des Travaux Publics, Monsieur le Syndic de la Ville de Milan et Monsieur le Sénateur Colombo, l'un des Présidents du Congrès, des paroles de bienvenue si aimables qu'ils ont bien voulu nous adresser.

On the conclusion of the speeches, president Colombo, in pursuance of His Majesty's instructions, declared the inaugural meeting to be closed and convened the sectional meetings at two o'clock in the afternoon at the Villa Reale.

Ist SECTION

(Inland Navigation)

Ist SESSION

Monday, September 25, 1905

Afternoon Session.

President :

Senator Baron CASANA.

THE PRESIDENT. — Before welcoming all those who have come, I deem it to be my duty to announce that the Permanent International Board has thought best, in order to gain time, to appoint the foreign Vice-Presidents and Secretaries, and that their names will be found on pages 22 and 23 of the Guide of the Congress. So, if the Section approve, I will invite the members designated to take their places.

The Section having assented, the President read the names of the appointees and asked them to take their seats, the foreign Vice-Presidents on his right and the Secretaries on his left. He then asked the foreign delegates to take their places.

The following answered the roll call.

Foreign Vice-Presidents :

Messrs. Mailliet- Toussaint, Belgium.
Willgerodt, Germany.
Dr Krause, Germany.
Maurice Levy, France.
Harry F. Hodges, United States.
Lipine, Russia.

Messrs. Dura Deking, Holland.
Mendès Guerreiro, Portugal.
Léopold Faragò, Hungary.
Sir Charles Moore Watson, England.
Albert De Morlot, Switzerland.

Foreign Secretaries :

Messrs. Albert Lambin, Belgium.
Wilhelm Rehlen, Germany.
Cuénot, France.
Prof. Henry Merczyng, Russia.
F. Nelemacy, Holland.
Gabor Steineker, Hungary.
G. A. Rusca, Switzerland.

The President. — The solemnity of this morning's meeting, graced by the presence of the King and Queen, shows how important is this International Congress in the eyes of the country. It is for us, now, to rise by our work to the level of the great merit acquired by the Permanent Association of Navigation Congresses, which calls these useful meetings into being, as was shown so especially this morning.

The studies of the learned men who will speak on the questions submitted to the Congress and the important works presented in the form of communications, will greatly facilitate discussions and conclusions, and we may be sure that this Xth Congress will be as fertile in results as were those which preceded it.

As we are about to take up problems relating to Inland Navigation, we are led to call up historical precedents, so that for us Italians, our minds turn back to far distant times and we remember that inland navigation was the object of great attention and of important works on the part of the Etruscans, Romans and Venetians; and as it was desired to show Italy the honor of holding this Congress in one of her cities, the choice fell rightly on Milan, the centre of a region in which there still exist, as though to bear witness to its past supremacy in the matter of inland navigation, works which bear the deep impression of the genius of Leonardo da Vinci, who, gathering in the ideas of those who went before him, developed and perfected them.

Great has been the development of inland navigation in other countries since those days, and only this morning, the Hon. Mr. Colombo recalled them and Baron Quinette de Rochemont spoke of it particularly.

Compared with these countries, the state of affairs in Italy has remained, unfortunately, very different. The vicissitudes of politics are its justification; but it cannot be denied that to-day, even in Italy, public opinion is persuaded that a well considered project for inland navigation should be provided.

The works of the Commission of 1900, presided over by that learned engineer the Hon. Romanin-Jacur, my colleague here in the presidency, bore, amongst others, a large share in this awakening, because its report of 1903, rich in data and the fruit of these studies, showed clearly how inland navigation could be re-established successfully in Lombardy and Venice.

To Day the Congress can, if it so desire, become acquainted with the very recent vast and learned publication of the first part of the technical works of a second Commission charged by the King's Government with completing the studies of the first Commission in the Valley of the Po, and extending them to all parts of Italy suited to the development of inland navigation. This publication is also due to the Hon. Romanin-Jacur, as Chairman of the Technical Committe of this Commission. All this — as stated already this morning by the Minister and it does not seem useless to repeat it — shows that Italy is not unworthy to-day to receive you, Members of the Congress, as her guests, you who have come from lands where inland navigation is in full course of development, and I can assure that she will follow your labors with anxious interest.

The arguments to be drawn from the questions to be discussed and from the communications received are very important.

The first of the questions supposes — and our wish should be that it be realized — that, in the industry of transportation, antagonism between railways and waterways cease. The multiplicity of means of transportation, to the advantage of exchange of industries as well as to that of consumers, would be for that cause alone a serious reason to set aside this antagonism. And besides, it is clear that where rail traffic is limited, communications by water, suitably connected with the railways, may increase it, whereas, on the contrary, wherever the traffic is heavy, and as there is a limit to the capacity of railways and to the means of enlarging stations, the assistance of canals may be providential ; they would

be able to relieve the railways of the unremunerative transportation of bulky freights of small value.

In the controverted question of the influence of the destruction of forests, the many articles presented will bring light, articles which appear to be founded on the observation of facts, and very useful too will be the discussion relating to light draught vessels which may be of assistance in developing inland navigation. But of special interest to this Congress is the arguing as to the means suitable to overcome great differences of level in navigable canals.

It is to be hoped that this question, left unsolved by the Düsseldorf Congress, will be able to lead us to a conclusion, now that the results of the competition for lifts recently opened by the Austrian Government are known. This competition once more shows the modern activity which stops before no problem, however great it be, provided that it succeed in facilitating communications and exchanges and in rendering them more active.

The Hon. Mr. Colombo said this morning that it was by no means rash to think that the Ligurian Sea would be connected with the Adriatic, even by crossing the Alps, at a not very distant day; and while I join in this flattering confidence, I recall, as a matter of honor, Engineer Cappuccio of Turin who, as for back as 1865, developed the project for a navigable canal from the Ligurian Sea to the Po.

Looking ahead in thought to the day when communications will have become, by means of such on advance in technical science, more and more easy among the Nations, we are happy in supposing that these relations between peoples will become more frequent and that, while the benefits of civilization will be multiplied, the inhabitants of the various lands will have more numerous occasions for knowing and appreciating each other, and that the ideas of peace and concord, which should be the aspiration of each country, will be more and more widely diffused.

It is in the name of fraternity between all civilized Nations that I welcome and thank not only our foreign Vice-Presidents and Secretaries, but all who have come hither from distant lands, and especially those who, by their writings and the study of the questions proposed, have prepared learned materials for our discussions.

The President closed his speech by welcoming the Members of the Congress in their several tongues, that is : in English, French and German.

The President. — Commander Maganzini, who has to make some remarks to the Meeting, has the floor.

Mr. Maganzini makes some remarks in French about identification cards and other special points for the Members of the Congress.

He also reminds the Members that two publications of special importance have been presented to the Congress : one relating to the studies of the Commission of 1900 for navigation between Venice and Milan, the other containing the propositions for the navigation of the Po by the new Commission appointed in 1903 to consider the subject of navigation in the entire Kingdom. It demonstrates the importance of studying the question of navigation in Italy, beginning at least with its greatest river, and then proposes to elect a Commission which will make a report on these volumes, at a later meeting, by asking the President to be so kind as to undertake the selection of the Commission to study this matter.

The President. — The Congress has heard M. Maganzini's proposition. The works of the Commissions of 1900 and 1903 have been collected in a volume and the aim of Mr. Maganzini's proposition is to ask the Congress to delegate to the Foreign Vice-Presidents the choice of three persons who will examine these communications and submit a report. If there be no objection, I déclare the proposition carried.

Messrs. Levy, Dura Deking and other foreign Vice-Presidents show the impossibility of an improvised Commission's gaining a thorough knowledge of very important technical studies in time for a near meeting. They then declare that, in spite of the great interest of the Maganzini proposition, it could not be examined by the present Congress with the care which it deserves. But every member will study with interest the beautiful work presented by M. Maganzini.

The President. — It is understood then that the Congress acknowledges the presentation of these studies and that it rejoices that Italy too has started on the road to serious studies.

Before beginning the discussion, it will be remembered tha article 4 of the By-laws requires that the names of those who desire to speak shall be recorded. It will also be added that each time the

speakers have the floor, they are requested to give their names distinctly so that the secretaries and stenographers can record them.

Finally, as Volapuk is not yet numbered among the spoken languages, and as, consequently, we must speak in four different languages, I have the honor to inform you that, in order not to repeat too much, I have thought that it would be well to translate the ideas set forth by the speakers only when some Member asks that the remarks be repeated in a given language.

Now the order of business gives as the first question : « On the utility and organization of mixed transportation, that is by railway and water way. »

Mr. Moschini. — As general reporter, I have had to examine and I have studied with great interest the reports presented : one by Mr. Whinery, one by Messrs. Crotti and Carissimo, two by Frenchmen, Messrs. Captier and Tavernier, and a Russian report by Mr. Maximoff.

Mr. Whinery's report is very interesting because it sets forth the special characteristics of the Americans and English; that is : that of considering speed and rapidity of communication much more than any eventual difference in rates. Mr. Whinery says that for the special character of the English speaking peoples and, generally, of the organism of his own service, it is very important to move quickly. Consequently his conclusions would scarcely be favorable for a Navigation Congress, because he believes rather in the future of railways than in that of inland navigation. Still he makes one reservation and says : « If inland navigation can grow in new fields, which we do not yet know, by means of electricity, it may be that it will gain the upper hand of other means of transportation, even in America, as has happened in the past. »

However, Mr. Whinery, not having penetrated to the real sense of the question which interests us, makes comparisons between transportation by river and by rail; but he does not consider the real question under discussion, that is mixed transportation, or transportation of which a part is carried by water and a part by rail.

Messrs. Crotti and Carissimo treat another question, that of using at certain ports, such as Genoa and Venice, a system of discharging freight by means of aerian cables; they describe the most generally used cable ways and then offer special projects to be applied at Genoa and Venice. Here too, it is not really a question of mixed

transportation by railways and inland navigation and consequently I have been unable to pay much attention to their propositions in my general report.

On the other hand, those who have really understood the question and treated it thoroughly are the Frenchmen Messrs. Tavernier and Captier. Their reports are not to be dismissed with a mere summary notice. It is also interesting to note how Mr. Maximoff presents the question from a special point of view; he sets forth the relations between the railways and inland navigation in a country like Russia, where the Government gives great assistance to inland navigation, and where, consequently, every means is studied to make exchanges between the rivers and the railways as easily and economically as possible.

Messrs. Captier and Tavernier are carrying on their warfare in a country where the railways still belong to private companies; consequently they speak in favor of a law which will oblige the private companies to desist from their systems of fighting river transportation, not only by means of a tariff, but also by prohibitive means such as special rates or special difficulties in discharging or transshipping at inland ports. They seek to excite public opinion and the French Government to provide, by means of special laws, for exchanges between rivers and railways being made as easy as possible.

When I came to examine these various reports, I asked myself whether the problem of mixed transportation, partly by rail, partly by water, were fully solved. And frankly, I had to answer negatively. I saw rather that there was another point which could be developed and which touches our Italy especially. Italy, considered geographically, has two distinct parts : the northern part where an inland navigation of a certain importance can be built up, because there is a very important and far reaching river, the Po, which runs through it all and because from this stream various tributaries lead to other points of Northern Italy. While a part of Central and Southern Italy does not lend itself to inland navigation. But there could be a very real navigation, although not wholly inland, along the shore of the Adriatic, a small coasting trade. The small coasting navigation has gradually declined until it is no longer of any importance.

I asked myself whether it were not useful to look also into the problem of the small coasting trade, and the union of the inland countries lying along the Adriatic with the many ports which dot its shores.

And considering the question from this point of view, the conclusions which I reached and which I wish to submit to the Congress have become much broadened. Instead of speaking only of mixed transportation of railways and inland navigation, the argument can be extended, by considering also the relations which may exist between the railway and the small coasting trade. As was said at one of the last Congresses, after all said and done, river navigation is but the continuation inland, as far as possible, of ocean navigation, that is : river transportation may be considered as small ocean coasting trade, and as, at the last Congress, much interest was expressed for these small ocean craft which could serve at the same time for transportation on arms of the sea and then on rivers, I believe that the Congress might accept this extension of the problem and conclude by speaking of the relations which may exist between ocean and river transportation and the railways instead of the usual relations between inland navigation and railways.

But Mr. Maximoff's report presents another aspect which I have tried to summarize : it often happens that, at the very point where the railway reaches the water, there are no difficulties in passing from one to the other, and that the difficulties appear afterward along the main railway lines for sending the cars off on secondary lines or toward tramway lines.

According to Mr. Maximoff's report, there have been created in Russia general freight Committees whose duty is to send forward all the freight, arriving at certain points, over all the main and secondary railway systems of the country, thus seeking to bring the various organisms into touch with each other; the difficulties which goods encounter in pursuing their way being known, these difficulties come to be suppressed and a greater expansion is given to the general movement.

Having thus briefly summed up the ideas of the various authors of the reports, I will read the conclusions : it will be easier to start the discussion on these. I am ready to give all the information which may be asked for.

At this point, Mr. Moschini, the reporter, read in Italian, French, German and English the preambles *a*), *b*), *c*) and the conclusions I, II, III.

a) Whereas river ports are indispensable annexes of navigable highways as stations are of railways;

b) Whereas the small ocean coasting trade may find a means of considerable development by creating, along the coast, a number of economically equipped ports connected directly with the railways;

c) Whereas the river coasting trade is, so to speak, the continuation inland of the ocean coasting trade and the two means for carrying freight, by water and by rail, form an indispensable element in the general economy of the country :

The Congress resolves :

I. That the Governments consider with all possible care the construction of ports for the ocean and river coasting trades, by supplying a modest plant, and in all cases by bringing in the tracks of the nearest main or secondary line;

II. That, by means of instituting General Councils, rates, or other methods, friendly and rational relations be established between the boating industry and the railways and between the various main lines and secondary lines;

III. That the points of contact between the railways and navigable highways be increased as much as possible, by adapting thereto all the technical, administrative and tariff means which may bring about the creation of ever increasing mixed transportation.

The President calls on Mr. Tavernier.

Mr. Tavernier. — In my study of mixed transportation, I considered particularly the region between Paris and the Mediterranean, formed, between Beaucaire and Chalon-sur-Saône, a length of 350 km., of a single artery; and this single artery, lying somewhat apart from the main centres which could furnish traffic to navigation (the collieries of Saint-Etienne and Alais, the port of Marseilles, etc.), needs, necessarily, connecting ports in order to be suitably supplied. So far as statistics would allow, I endeavored to state exactly the importance and the kind of the traffic on the navigable highways situated in the region considered, as well as the nature and importance of the freight transferred from car to boat or from boat to car. Tables, which the strictness of the by-laws of the permanent Association did not allow of inserting in my already too long report, permit all the known elements of these statistics to be presented in condensed form; it will be a pleasure for me to send these tables, which have been printed in the Transactions of the Transportation Office of the Chambers of Commerce of the South-

East of France, to those of our colleagues whom they may interest. I will sum up here the essential figures by saying that, on all the navigable highways considered, the traffic of 1902 reached :

In loading : 6,760,000 tons.
In discharging : 6,605,000 tons.

In all this total, the mixed transportation appears with the two following figures :

Freight transferred directly from car to boat : 750,000 tons.
Freight transferred directly from boat to car : 460,000 tons.

These figures, let me hasten to say, give but an insufficient idea of the mixed tranportation.

First, as the result of the lack of connecting ports, direct transfer is not possible everywhere, and at many points recourse must be had to wagons in order to transfer freight from car to boat or the reverse. The statistics are therefore incomplete and the figures which they give do not set forth exactly the present situation. But if we go further and try to form an idea of the importance which mixed transportation would take if the connecting ports were suitably organized, we are led to think that, for many reasons, it ought to be infinitely greater. If the inland navigation ports be compared with sea ports and railway stations, one is struck by the inferiority of their organization, which arises mainly from the hostility of the Great Railway Companies. Thanks to the assistance of the great companies, the sea ports and stations form transfer shops which are ever improving. The efforts of these powerful societies, particulary those of the P. L. M. Co. (1) which alone serves the region which I have in mind, tend on the contrary to isolate the inland navigation ports which were formerly very prosperous. In the valley of the Rhone the first railways were built, from 1827 on, to connect the river with the principal centres of production. The railways from St-Etienne to Givors and Lyons, from Alais to Beaucaire, from Marseilles to Avignon, were regular draymen for navigation. At the port of Givors, which has been steadily abandoned since it fell into the hands of the P. L. M., 400,000 tons of coal were transshipped yearly. The Chambers of Commerce of the South-East, which I have the honor to represent here, have spared no efforts to have things otherwise, and these

(1) P. L. M = Paris, Lyons and Mediterranean.

Genoa. — The quays.

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efforts bear witness to the interest which Commerce attaches to mixed transportation. So far they have accomplished little. A law is in preparation which will oblige the great Companies to let their cars come alongside of the boats, and will allow, wherever this may be useful, direct transfers. Will this law, made necessary in order to satisfy the principle of equality of treatment inserted at the beginning of the specifications of the French railways, be sufficient to give to mixed transportation the extension of which it is capable? Perhaps there should be no illusions on this point. Good will cannot be forced, and without reciprocal good will difficulties are always to be feared. Still there is some reason to hope that the situation in France may change and that good harmony will follow after struggles which were formely very lively and which still persist. The P. L. M. Co., whose system and whose lines are expanding everywhere in the valley of the Rhone, will realize that this line of communcation can bring it more freight, by nourishing its secondary lines, than it will take away to the detriment of its main lines which, for that matter, are threatened with overcrowding.

I should like to end this subject by another remark which seems to me of special interest to Italy where so much thought is given just now to reorganizing the management of the railways. It is above all the extent and centralization of the P. L. M. system which has hurt the development of junction ports and mixed transportation. If, as was about to take place, the P: L. M. system had remained separated into two lines developing one to the North and the other to the South of Lyons, Lyons would have become, as has Mannheim by means of the Baden railways and for the same reason, a great inland navigation port. If the Southern system, which earnestly sought it, had extended its tracks as far as the Rhone and Marseilles, it would have created a great transfer port on the river. If the management of the Italian railways be decentralized, as I believe there is some thought of doing, by forming autonomous systems whose Directors will be interested in developing their own affairs, each of these systems will naturally stretch out its hands to the navigable highways which will bring it freights in the same way as the adjoining lines of railway. The question of the good organization of mixed transportation will thus be solved in a friendly way, that is by bringing interests into accord. Wherever the friendly solution does not appear likely, several systems for organizing transfer ports have been

pointed out to give a rational mode of working without asking the railway Companies to take any active part. I shall do no more than mention the interest resulting from a study of the innovations which have taken place recently at the port of Genoa in the direction of Autonomy. There is no doubt whatever that here will be found a valuable example to be imitated in organizing the principal inland ports.

Mr. Merczyng. — From what Mr. Tavernier said a moment ago, I think that, most of all, in countries where the railways are opposing navigation, the governments should put out every effort to support the relations between the railways and the navigable highways.

Mr. Colson. — I should like to call attention to one point which explains the little enthusiasm shown by the railways in the organization of mixed transportation in France and in countries having the same legal status for their lines of communication. What makes the interest of this organization is its allowing freight between two points to take the line which is of itself the more economical, even if a transfer be involved, and it is only when mixed transportation gives a less net cost that there is any public interest in its working. The case is frequent in Germany, where the admirable natural lines of the Rhine, Elbe, etc., improved by relatively inexpensive works, lead traffic to the interior of the country, under conditions which the railways can scarcely rival, and hand it over to them at the junction port.

There is in France nothing comparable with this, save the Seine whose bends make up in part for these qualities. The net cost of transportation on our small section canals may be compared with that of the railways, but on the Rhone, which has been especially mentioned, the cost is much higher.

When freight is interested in following the navigable highway or the mixed line, it is nearly always because the boating industry pays no taxes, whereas on the railway the traffic must pay the interest on and amortization of the capital invested. A railway company which is obliged to remunerate this capital, does not lend itself willingly to connecting with a road which will take this traffic from it even when the railway is better placed to serve it, simply because so doing makes the tax-payers meet the cost of

maintaining the navigable highways, the repayment of the cost of the artificial water ways and that of the nearly as great expenses (250,000 francs per km on the Rhone and more on the Seine, if I remember rightly) for making some so-called natural water ways navigable. And it cannot be said that there is any public interest in attracting traffic to the water ways for a fraction of the trip, when the freight pays on this line, for transportation alone, and without any dues, a price nearly equal to that which, on the railway, would leave, after paying all operating expenses, a very appreciable net product to contribute toward the maintenance of the line and the remuneration of the capital.

Mr. Tavernier. — Mr. Colson has just raised a question, that of navigation dues, which has no part in the programme of this Congress, but which has often been debated at preceding Congresses. Can a boating industry, freed as it is in France from the dues corresponding to the first cost of the line properly so-called, pretend to be treated on a footing of equality by railways which make a great noise, more than necessary perhaps, about having their rates burdened by « dues » which count in all the costs of construction ?

To confine myself to the region which I have considered, I can offer in opposition to Mr. Colson an argument of fact. I stated in an article published in the Transactions of the Transportation office, that the P. L. M. Company had received from the public funds, at sundry times and for various lines, a total of grants absolutely sunk (*à fonds perdu*) very much greater than all the expenses for all the navigable highways lying within the limits of its system. At the present moment, while the programme adopted for the construction of new lines of navigation provides for a contribution of 50 % by those interested, the P. L. M. Company, according to the agreements of 1883, consented to build new railway lines which were to be paid for almost exclusively by the State. And if the objection be made that it is unproductive secondary lines which have received these subsidies, while the navigable highways serve the principal directions capable of furnishing a remunerative traffic, the answer is that it is just these tributary lines which furnish the traffic of the main lines, and that the State, when it takes upon itself the cost of the former, could well obtain, at the least, that they should connect with the navigable highways as they do with the main railway arteries,

bringing impartially to each the share of the traffic which belongs to it.

I agree perfectly with Mr. Colson that this share should be determined by the public acting under its own free choice. If the merchant or the manufacturer resort hereafter to mixed transportation, if he desire to use it still more, although it may be complicated, annoying, uncertain and slow, it is surely not through a desinterested fondness for navigation, it is because he finds there certain savings which are indispensable for the very life of certain great industries. For them, the utility of navigation is measured exactly by the proportion of freight which they intrust to it, and they are convinced that a good organization of transshipping ports would increase greatly this utility. A single port, that of Roanne, of which the relief plan can be seen at the exposition of the Congress, has been suitably organized through the energetic and persevering efforts of the Chamber of Commerce of Roanne, which for 30 years has never wearied in demanding from the P. L. M. Co the necessary improvements. This very recent success, the only one of the sort which the Chambers of Commerce have had to record, has borne immediate fruit as testified to by the statistics. There are now transshipped at the port of Roanne nearly 300,000 tons a year.

I think also, Gentlemen, that too much importance should not be attached to theoretical arguments of a « moral » order such as that developed by Mr. Colson and which I have endeavored to combat by recalling the largeness of the subsidies granted to the P. L. M. Co. The general interest of the country required that after large sums have been spent on the water ways, they should not be left unproductive for lack of connecting ports. The relatively small additional expense involved in establishing these ports « will pay » and will show the value of the preceding expenses.

The State should act as would a good manufacturer who, after having built a costly factory, does not neglect to provide the outlets which are indispensable for his output.

Mr. Colson. — I should like to say a few words in reply to the objections just made to my statements. Mr. Tavernier observes that the State contributes largely to the construction of many railway lines as it does to that of navigable highways. That is true for mountain lines; but these lines never compete with roads having a good profile, a large circulation, on which the traffic pays largely

the interest on and the amortization of the capital, be it furnished by the State or by the companies; the whole question is to know whether the freight brought by secondary lines in regions where the water way does not penetrate, should continue its journey by rail or by water, and I say that it is inexact to consider this second way as preferable in cases where it is the liberality of the State, and not the technical superiority, which gives to the public the lower price. Mr. Tavernier said that once the two lines created, a country should use in each case the one which gives the lower rate, without troubling itself to find out whether the capital of the one is better remunerated than the capital of the other, just as a manufacturer, who has two plants for making the same article uses one or the other according as it can supply a given market more cheaply, without inquiring whether in this way one or the other plant will represent a better return for the capital. That is true; but the manufacturer in question would make curious errors if, in order to find out from which factory he would better obtain such or such product, he brought, in the one case, into the calculation of the net cost the maintenance of the buildings and the interest on the capital, while he left these elements out in the other. It was not to return to the question of dues, which is not now under consideration, that I led the discussion in this direction : it was simply to show that if the agreement for mixed transportation is not made as easily between railways and water ways as it is between railways operated by different companies, it is because it is much more difficult to conciliate the interests of enterprises working under radically different fiscal conditions than it is when the enterprises bear the same charges.

Mr. Sympher. — Gentlemen, it is to be regretted that no German delegate has treated this question. I believe that the reason for this is to be found in the extraordinary difficulty of the question here considered.

We have in Germany a greatly developed inland navigation. I was very happy to notice that Mr. Moschini showed, very especially in his report, that German inland navigation has developed greatly and that, on parallel lines, the railways have also gained largely, more so even than in any other European country. Consequently, you can deduce that railways are not always competitors which diminish traffic movement. The Prussian Government has set itself the task of increasing communications by land, by develop-

ing inland navigation and the traffic on railways, and I am convinced that in this the Prussian Government does all that it can.

We have already a large number of ports, so that communication between the railways and water ways has been established and is becoming daily more extended. But here too there are complaints, and the creation of transshipping ports is asked for. Important progress has been made, all the same. The water ways and railways complete each other. This must be not only admitted in theory but realized in practice. That is why I ask you not to accept the resolutions proposed in the form in which they are submitted. I propose to omit the preambles and the first two conclusions and to accept the last conclusion slightly modified.

Mr. de Bovet. — It is very true, as Mr. Colson has remarked, that the State has built canals or improved rivers at the cost of the tax payers; but I think that, in France at least, it has also taken a very large share in the cost of establishing railways and that not alone recently for mountain lines, but also formerly for those which Mr. Colson calls lines of very good profit and large circulation. From the fact of this intervention, which is continued under the form of guarantees, there has arisen something artificial, or, let us say, extra-industrial in the conditions for settling the rates which may be adopted for the lines of one or the other category as well as for the navigable highways; as to differentiating over the whole of a railway system, from the point of view of the share which the rates of each portion should bear, this is possible and may be rational, but the first cost should not be considered alone. I shall not dwell on this as it would carry us too far.

It may be said that the State, by making water ways at the cost of the tax payers, makes possible a competition, which may sometimes be rather hard, with another means of transportation which it has also helped to organize. Evidently it can do so, by reason of the very intervention which it had and still has in this organization. It this rational? I think that, without calling in theoretical considerations, I shall answer this question sufficiently by saying that in America, in this country where it is well known how hostile the State is to any intervention in industrial affairs and where it is far from having done for the railways anything comparable with what is done with us, the State is seen to be disposed to have a share in the creation or improvement of navigable highways. This

appears to be the case at least from the documents distributed to the present Congress.

From the moment that this double intervention occurs, whether rightly or wrongly, rightly in my opinion, it is evidently not in favor especially of the railways or especially of navigation, but in favor of trade. Either this should not be or it is necessary apparently that commerce should obtain by it the maximum of utility and development. This will be more easily reached if the railways admit, or let us say, if you will, submit to common rates, than if the two modes of transportation pretend to remain strangers to each other.

Mr. Levy. — In summing up the discussion, he proposes that the conclusions of the general reporter, Mr. Moschini, be adopted as to the third point, the first two and the three preambles being abandoned.

Mr. Sympher. — I agree to Vice President Levy's proposition, and I should like this to be repeated again for the other Germans. We therefore set aside the preambles as well as the first two points and accept the third.

Mr. Colson. — Joins in the suppression of the three preambles and of the first two points of the conclusions.

Mr. Vitta. — I believe that I express the general feeling by offering the thanks of the Section to Mr. Moschini who has studied the reports presented and has given such a clear synopsis thereof; and who, having spoken in German, has allowed Mr. Sympher to seize the conclusions.

Mr. Moschini. — Expressing his pleasure that his conclusions had brought the discussion on practical ground, reads the conclusion as modified. Suppressing the three preambles and points I and II, there remains only the third, viz :

« The relations between the railway and the navigable highway » should be improved so far as possible by all technical and » administrative means, and by rates which contribute to create » a constantly growing mixed transportation. »

This was approved by the meeting and the President declared the session adjourned.

I[st] SECTION

(Inland Navigation)

II[d] SESSION

Wednesday, September 27, 1905, at 9.30 A. M.

President :

Senator Baron Casana.

The President. — Gentlemen, I noticed at the last session that most of the Members did not understand Italian, but, on the other hand, that the greater part of them did understand French. As President, I wish that I also knew German and English, but that is not my case. I therefore ask your permission, Gentlemen, to use for to-day's session, and for those which follow, the French language in our debates. If it become necessary so to do, I shall take care to have translated in to English or German, as the case may be, such points as may not be clear for any of you.

Then I regret to inform you that it is impossible for the Minister of Agriculture to honor to-days session with his presence, and I communicate to you the despatch which be has had the kindness to send to the Congress :

« *Senator Colombo, Milano,*

» I have received your kind invitation for the Navigation » Congress. Just reached Rome, I wish the greatest success to » the important works of the Congress, which interest me greatly » as Minister of Commerce.

» My cordial greetings.

» Rava. »

Before beginning the debates of this session, I should like to ask the Members whether they have any remarks to make on the subject of the minutes of the last session.

Mr. Levy. — Says that he has no objection to the minutes as a whole; only he would like to have the French text of the minutes slightly changed. The resolution passed at the first session should rather be the following :

The section desires that the contacts between railways and highways for navigation be increased as much as possible by all the technical and financial means belonging to each country.

The English are asked if they agree to the text of the report in their language.

They make no remarks.

The President. — Gentlemen, the remark made on the subject of the report is really but a remark of form. We were all agreed as to the text of the report prepared in Italian. But these reports were presented in different languages and Mr. Levy has formulated his remarks. Mr. Levy desires that the conclusion in French be stated as follows :

« Les contacts entre chemins de fer et voies navigables doivent » être multipliés autant que possible par les moyens techniques, » administratifs et à l'aide de tarifs propres à développer de plus » en plus les transports mixtes. »

(The points of contact between railways and navigable highways should be multiplied as much as possible, by technical and administrative means, and by the assistance of tariff rates, suited more and more to develope mixed transportation.)

Gentlemen, it remains to appoint a general reporter on the first question for the closing session; I propose to you Mr. Maurice Levy.

The proposition is adopted.

The President declares the discussion of the third question as open and asks the general reporter, M. Crugnola, to set forth his observations.

Mr. Crugnola. — Gentlemen, as the general report has already been distributed to the Members of the Congress, it seems to me

useless to repeat here what every one has been able to read. I have tried in the first part to present, in a wholly objective way, a summary of the eleven reports presented, and if I have not done so as fully as might be desired, it is because of the resolution of the Executive Board which has limited the general reports to 20 pages.

In the second part, I have set forth what is important in the the special reports for the solution of the problem submitted to the Congress. These reports have furnished very rich and valuable material, so that all questions of detail in regard to each of the systems proposed and which were the object of discussion at the preceding Congress, by reason of the uncertainty hanging over them, may now, it seems to me, be considered as solved; hence the discussion will be circumscribed.

Still, even within these limits the problem may be considered in two ways, according as it be intended to examine the systems suited to overcome a high lift between two levels of a canal, for a difference of height at a given point, or else to rise over a total lift distributed over the entire length of the canal, in passing from one slope to another or from one hydrographic basin to another.

It is evident that in most cases the problem must be met by the second method; it has been treated thus by most of the reporters and the proposed resolutions which I have the honor to lay before you is conceived along the same lines.

Moreover, the problem in this form includes the other from the technical point of view ; because when it is a question of an isolated case, of a single lift at a given point, the solution may be sought from the technical and economical points of view alone. I dare to hope, then, that in treating the question in the form presented the intentions of the Congress have been well understood.

Since the preparation of my general report, the technical magazines have continued to publish articles relating to the International competition at Vienna; they have made known the mechanical and technical arrangements of the projects which have received premiums, and numerous details of construction relating to certain other projects to which the jury has awarded an honorable mention. All this is known and may be considered as being included among the elements which serve as a base to the discussion which is about to begin.

Among the projects which received an honorable mention is one of which the report has been received through the care of the Committee; it is a project for two locks each of 18 metres lift

separated by a section of the canal 400 metres long. Its author is Mr. Wilhelm, Engineer of the Ponts et Chaussées at Gap. This project confirms the opinion of one of the reporters, Mr. de Bovet, that for lifts of less than about 20 metres, resort should he had to locks. Each wall of Mr. Wilhelm's locks is made up of 15 buttresses connected by floors which form the bottoms of six storage basins. The consumption of water at each lockage is reduced to 2475 cubic metres, which is very small.

The large number of parts which make up a lock does not give rise to any excessive complication, as might be supposed, because it is a question of identical and little complicated parts, when they are considered separately.

In my general report, I have mentioned three special solutions, outside of those submitted for discussion : but I desire to point out a fourth one with which I only became acquainted after the said report had been prepared ; it is a pneumatic lift which its author, Mr. Marzola, Manager of the Zschokke Works, presented at the Vienna competition under the assumed name of « Avenir », one which the jury considered worthy of being taken into consideration.

It is a gigantic lock chamber, having a height corresponding to the difference of level to be overcome, against which the two reaches abut. A steel carrier moves vertically between the walls of the lock, under the influence of compressed air. It receives a boat from one of the reaches and raises or lowers it to to the other reach. The total weight including the water is 2010.6 tons and the air pressure from below upward is 2111.2 tons; that is a difference of 100 tons, which is sufficient up to the limit of the rise. The time spent in raising or lowering a boat is 21 minutes and 12 seconds, and there is no consumption of water.

I have desired especially to call the attention of the Members to these special projects which are not mentioned in the distributed reports, because they confirm the conclusions which I reached in the General Report, where I say that studies and trials whose object is to reduce the consumption of water should be encouraged, and also because it would be very useful for science to have, in some wholly special case, an application made of these original systems, whose ingenious and seductive ideas only await experiment to produce fruit and perhaps to bring forth results whose bearing was altogether unexpected.

I may be allowed to end with a few considerations which elucidate the resolutions proposed. It is, in my opinion, the lock which should offer, generally, the solution of the problem; necessarily, it should be transformed to keep up with the progress of navigation, and it is in order to start this evolution that it is desirable to have new arrangements practically tried, so as to diminish and even do away with any or all consumption of water, if that be possible.

The vertical lift is considered as an exception, a solution to be admitted for certain cases. Mr. de Bovet considers that « it » should only be applied if it be materially impossible to use any » other, because the lift reduces the capacity of the canal. »

And even the inclined plane offers a practical solution only under the condition of being able to concentrate at a single point the lift to be overcome, that is an exceptional case.

The project of the canal from the Danube to the Oder shows the difficulty of this solution. The total difference of level has been concentrated at seven points; but among these lifts there are four of 19 m., 25.1 m., 15.2 m. and 21.2 m., which do not justify the use of inclined planes. The other lifts are of 35.9 m., 43.5 m., and 35 m. respectively.

I have no doubt, Gentlemen, that the discussion will bring out more light and new elements; but I hope that it will place in relief reasons through which the Congress can arrive at resolutions similar to those proposed.

The President declares the discussion open.

Mr. de Bovet.

Gentlemen,

I may be allowed to suppose that you are all acquainted with the reports wich have been distributed.

Several of the reporters have made prominent the importance of the questions touching either the efficiency of a canal or the utilization of the plant which circulates thereon; it seems to me that even after them there remains something for me to say.

It is well understood that the capacity of a canal is just the capacity of its least capacious work, and furthermore it is self evident that, for works of the same kind, the possible efficiency

is greater as the height of elevation is less. And finally there is no doubt that for small lifts nothing begins to approach the old locks.

Hence more or less of the possible efficiency of a canal will be sacrificed as soon as there is introduced a single work with a high lift, or as soon as the difference of level is overcome with locks having a lift markedly greater than those formerly in use. But it is a necessity which arises from all the present conditions of the transportation industries, conditions which force navigation not to be satisfied with what was sufficient in past times. Is it necessary to ask as a proof of this what has become of the traffic on canals which have, on parts of their course, several locks sometimes only a few hundred metres apart, canals which used to render other service when there were only ordinary roads running by their sides?

As a matter of fact the efficiency of the canal must be sacrificed to improve that of the boats and of the hands who operate them, and for that nothing would be worth, if it were possible, the concentration at a single work of the whole difference of level of a slope. In a word, the lower the works the better for the canal, the higher the works the better for the boats.

To accommodate best these contradictory requirements, Messrs. Hermann and Prussmann have indicated a very ingenious, perhaps too ingenious mathematical solution, to which they will allow me to make two objections. The first is, that they neglected, in forming their equation, at least one element which will be pointed out further on and which, for that matter, I do not see how to introduce into a calculation ; the second is that it will very rarely happen that the surface of the ground may have a sufficiently mathematical shape to lend itself without excessive cost to the systematic realization of the best (*optima*) value of H. The slope of the watershed would have to be at the very least, a necessary if not sufficient condition, almost uniform and that rarely happens in fact except when it is, if not zero, at least very nearly zero.

Mr. Vernon-Harcourt is, I think, wholly right when, considering also this mean slope, but asking what it can really indicate, he concludes that, when its value exceeds a given figure, it must be considered that locks as they have been generally used up to now become insufficient, and that they must be made higher or something else must be sought.

But it remains doubtful at least whether it be possible to give regularly to these higher works a height which varies but little from the calculated mean.

There are in the reports several estimates of what might be the efficiency of these works having a greater lift than those generally in use up to now. It is not worth while to dwell upon a few slight differences in the valuation of time, but there is one remark which appears to me to force itself to the front.

Messrs. Hermann and Prussmann, considering the case of a longitudinal lift, assume that it will have a single track. Why? Such works are provided generally with a double track; it is rational thus to equip them, and it is rational also to make comparisons between works involving costs of construction of like order, which is the case for a double track lift or for all the single locks of great lift, which may replace it; — a system of a series of double locks involving then a much greater cost.

In this connection I cannot help noting in the reports differences of cost which must lead to hesitation in accepting conclusions. For example : Mr. Smrcek puts the cost of a lock of 10 m. and small consumption of water at 600,000 crowns, while Messrs. Hermann and Prussmann put it at 1,000,000 marks, and I think that they are more nearly right.

If a longitudinal plane have two tracks, then the value of « Z » given by these gentlemen should be doubled, let us say less than doubled to take into account an increase of time lost, for example multiplied by 1.75, in any event much greater than that given; if it be doubled there will be found a value greater than the Z corresponding to a lock for any positive value of the lift.

Mr. Smrcek considers, it is true, a longitudinal plane with two tracks, but he assumes that the speed will only be 0.50 metre. Why this figure? I really see no reason for not granting, with the greater number of the authors of projects, that this speed will be 1.00 metre; I consider that we may hope to exceed this figure; perhaps practice will show some day what it will be. If 1 metre be assumed, there is obtained, with Mr. Smrcek's figure, a duration of passage, for two boats in opposite directions, of 32 minutes in the case of an inclined plane 40 m. in height instead of 28 minutes in the case of a lock of 10 m.; 36 minutes with locks of 15 m., and 44 minutes with locks of 20 m.

As this author, in considering the case of the canal from the Danube to the Oder, expresses the hope that it may be built with

locks and the fewest possible number of levels, we must assume that he contemplates the use of locks of 10 to 15 m.; and really it seems to me possible to conclude from the preceding remarks, based on figures as given by the reporters themselves, that the efficiency of inclined planes, at least up to a height of about 40 m., is quite of the some order as the efficiency of locks of 10 to 15 m. in height; and it must be supposed that every one agrees that this last is acceptable.

I have only spoken here of the efficiency of the work without caring for the time gained by the boat, which would be 15 minutes for the horizontal distance of 1 km., at the rate of 4 km. an hour, and 13 minutes for manœuvres, by taking the figures of Mr. Smrcek and by comparing à 40 m. lift with 4 locks of 10 m. each. This concerns the second side of the question, the utilization of the boats. It is easy (and this is done in the reports) to find the total of the times gained for a given length of trip, and to find that they only represent a few hours of the whole time spent on the entire journey, and to say with Mr. Smrcek that these advantages will be much reduced by the waiting of trains at the lifts. In the first place, will there be any trains? Nothing is less sure : for my part, I consider that, when boats have to be locked singly, traction can only be carried on under good economical conditions provided that they can be hauled separately. If that should cease to be true, it would only be in the case of very long levels and very small trains; I say very long levels and consequently machines of high lift. Then, whether the boats arrive separately or in a train at the entrance to the works, they will lose time if the works be not free; this is sure, but it is independent of the nature of the work. In every case, I have indicated it by a word when beginning, and this remark brings me back to it, all the calculations presented neglect one essential element. They all suppose that the whole of the operations provided for will be performed with a regularity comparable with that of the time table of a railway. Such a supposition is clearly inadmissable in connection with navigation. This, among all methods of transportation, is the one most subject to the greatest causes of irregularity, this is its special failing, the one against which we must be forewarned, because, as a matter of fact, the regularity of a canal service is more important in turning to the best advantage both the water and the boats than is the rate of speed or the quickness of operating the works. Now, every obstacle on the way is, evidently, a risk for aggravating or for

multiplying the causes of irregularity, and consequently the more levels there are the greater is the difficulty in avoiding delays.

What coefficient should be introduced into the calculations in order to bring in this element? I declare my complete inability to determine it. I might seek its importance by examples if the time reserved for each communication did not have to be very limited; but I think that it is beyond calculation, and that is why, in this case, we must not hold exclusively to the indications derived from mathematical operations alone.

I will add, in conclusion, that I see no necessity for having all the works along a canal of the same type. As to the lock keepers, each one has to handle only the one to which he is accustomed. As to the boatmen, what they do is reduced to entering and leaving a lock ; aside from a few precautions, it is always the same thing, the essential for them is that this same thing should recur as rarely as possible.

This being so, if the line lead at certain points to having differences of level of 15 to 20 m., it is clear that vertical lifts should be used, and it is evident that those who are especially interested in the efficiency of the canal should recommend them. It seems however that such differences can now be overcome by locks. These will be, evidently, more complicated than the old locks — which is not surprising as they give much more ; — they are not so much so, however, if practice justify the previsions of the authors of the projects, as not to represent a work which every one would prefer undoubtedly to a lift. It is especially pleasant to be able, in this country which gave them birth, to foresee this great extension of the domain accessible to these works.

If the line of a canal should lead to the useful construction at some point of a much greater difference of level, I really see no objection to overcoming it by an inclined plane, and I think that that would be better than two locks.

The limit at which locks or lifts stop will, doubtless, not vary much. As it is here merely a comparison between costs of construction, it needs no prophet to show this, as the too rapid increase of these costs for vertical works must always obey the same laws.

Transverse planes do not seem, in spite of their advantages, to offer yet the same degree of safety as longitudinal planes. The future will tell whether it is not because they have not yet

Port of Genoa. – The shipbuilding yards

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been so closely studied, perhaps because they have been pointed out under circumstances of very broken country where, up to the present time, there has been less thought of introducing canals.

At all events, I think that the further we go the more necessary it will be found to build new canals with the fewest possible number of steps, and that the possibility of making the heights of steps necessary to realize this desideratum is now seen.

M. Prussmann. — Conclusions : The basis on which to judge the systems suited to overcoming high lifts between the levels of canals, lies in the most important characteristics of the various systems, that is to say mainly : capacity as to the number and speed of the boats carried, first cost and cost of maintenance, safety in handling boats, and construction.

I. Up to 15 m., locks are the best apparatus. With storage basins, the water consumption is greatly reduced, without however increasing too much the time of lockage.

II. For greater differences of level, we must consider flights of locks, vertical lifts able to rise to a height of about 25 m., or else flights of lifts ; longitudinal and transverse inclined planes may also be considered, and eventually new systems. A typical system for all heights or for certain fixed heights cannot be given.

The system must be chosen in all cases by taking into account the site and conditions of construction, navigation and traffic on the canal.

For the site, there must be considered the total height and slope, the nature and surface of the ground, the water supply for operating and the eventual use of hydraulic forces.

As to the systems, it is well to remember that flights of locks and of lifts demand, with increase of height, a steadily growing increase in the costs of construction and operation ; but they retain the same capacity for traffic as in the case of less heights. The expenses for inclined planes with a single lift increase but very little as the height increases, but their capacity for traffic becomes notably reduced. The division of a high lock among several lower ones, but having in all an equal height, does not increase the cost of construction, whereas the division

of the works of other systems multiplies the total cost very nearly in inverse proportion.

III. It appears useful therefore to direct studies and experiments :

a) for locks, toward quickness of manœuvring and storage basins ;

b) for lifts and inclined planes, toward increase of capacity for traffic, economy and safety in operating ;

c) for all systems, toward details of the economic value of the apparatus, taking into consideration the following important points :

Dimensions of canals and boats, traction of boats, their mean and maximum speeds, passing points, time of lockage, commercial speed of boats where locks exist, traffic capacity for the number and tonnage of boats, cost of construction and maintenance, cost of locking for each boat (operating and maintenance, fuel and water for supplies, total annual expenses, interest and sinking fund, value of the time lost by locking), length of the levels in order to avoid the unnecessary stopping of boats before the lifting apparatus, traffic on canals where the boats are towed.

Mr. Gerdau. — Mr. Crugnola's general report is very clear and gives a full idea of his mode of looking at the matter. The conclusions given at the end of his report are exact, and it would be well to have them accepted by the Congress in conformity with the proposition of the general reporter. The lock is a simple plant when it is a question of small differences of level. In the case of greater lifts, a flight of locks is no longer a simple plant. As the general reporter said in his conclusions, a flight of locks can only be considered in the case of a double lock, for lifts of average heights and where there is a sufficient water supply. Hence the use of the flight of locks is restricted.

It may be said that a flight of single locks is an uneconomical plant and one of small value. If the flight is to furnish a circulation both up and down at all times it must consist of double locks. From the technical and economic standpoint, single locks only work advantageously when they are far enough apart for the time spent in going from one to the next is equal to the duration of a complete lockage of a vessel up and down. It

follows from this that if a lockage requires 30 minutes (up and down) and the speed of the boats is from 6 to 8 kilometres an hour, the locks should be 3 or 4 kilometres apart.

The agitation of the water which takes place when the locks in the level are emptied also requires such an arrangement.

I also accept the general reporter's opinion limiting the use of flights of double locks and of vertical lifts to 25 metres. A flight of greater height becomes dangerous by the fact that if one of the numerous mechanical appliances of which it is composed fails, the whole flight, or at least a great part of it, is put out of service.

Nor does the construction of vertical lifts more than 25 metres high offer any security, because the mass of the head bay interferes with the safety of the entire work if the nature of the ground is not essentially favorable. A vertical lift with floats like that at Henrichenburg is not to be criticized on account of the mechanical appliances used in its construction, but on account of the danger offered by the mass of the high head bay with its retaining walls and its foundations. The use of an iron trunk (Brücken-Kanal) applied to the head bay changes nothing in this respect.

In this case the inclined plane should be adopted, as Mr. Crugnola says in his conclusions. The inclined plane is a simple solution economically and technically, provided that it remain within the technical limits given by the service of a single lock.

I was surprised to find in the reports of some of these gentlemen, for example in those of Messrs. Genard and Vernon-Harcourt, altogether erroneous ideas about the Henrichenburg lift. This lift which was finished in 1898 and put into permanent service in 1899, when the Dortmund-Ems Canal was opened, has worked for 7 years irreproachably and satisfactorily, and since then there have been no accidents or interruptions of any importance. Furthermore the operating expenses of the Henrichenburg lift have been very small. The consumption of power required by a double lockage, that is : the lifting of one boat and the lowering of a second, requires but 10 KW-hours, so that the lockage of four boats, including all accessory services, *e. g.* handling of gates and boats by capstans, requires but 20 KW-hours. With a service of 15 hours, the consumption of power is, therefore, 300 KW-hours, which at the rate of 4 to

5 pfennigs, or 6 centimes, is but 18 francs a day for handling 60 boats. The total cost of operating and maintenance of the Henrichenburg lift is 18 to 20,000 marks (= $ 4,500 to $ 5,000) a year.

In view of these very favorable technical and economic results and of the strength exhibited by the whole work for 7 or 8 years, it is astonishing that foreign reporters, one of whom even says : « according to the opinion of the engineers who studied the » construction of the Henrichenburg lift and superintended its » execution themselves »
depreciate this work and consider themselves authorized to say that the lift should not be taken as a model and would not be built again on account of its installation which is open to criticism. As the constructor and, above all, as the responsible constructor of the Henrichenburg lift, I am naturally very much interested in putting an end to such erroneous opinions and I declare as false the rumor, which has been spread abroad, that such an opinion has been formulated among the engineers who built the Henrichenburg lift. Besides this, this lift is, by reason of its constant good working, its own best defender against its antagonists.

It is said in some of the above-mentioned reports that, among others, the hydraulic lifts of the Clarke system are better than the one at Henrichenburg, without there being any proofs offered to sustain the claim. Now, it is well enough known that all the lifts built in accordance with the Clarke system have had very serious interruptions of their service which have caused these works to lie idle not only for a day or a week, but for one or more months and even years. Moreover, the consumption of power of a «Clarke» lift for vessels of 350 tons, as given by Mr. Lefebvre (205 cubic metres of water for each lockage), is far greater than that of the Henrichenburg lift : a consumption of 205 m^3 of water raised to a height of 15 metres, and taking as a base a useful work of 0.6 × 0.8, gives a consumption of power of 17,5 KWh, while the Henrichenburg lift which raises vessels of 600 to 800 tons requires only 10 KWh.

If a flight of locks were to be built at Henrichenburg as a second means for raising boats, which however, in my opinion, is not yet settled, it would not be on account of technical or economic reasons which might be raised against the Henrichenburg lift, but for motives which do not touch this question at all.

Messrs. Prussmann and Hermann add to their report several comparative tables about lifts and locks : the respective calculations were made in accordance with formulæ previously fixed.

It is difficult to compare, by means of formulæ, such apparatus of different construction, as these formulæ depend on arbitrary propositions. On the one hand, for example, the arrival and departure of vessels, the time of lockage, the handling of gates, etc., cannot be fully assimilated as the mechanical means, even in like systems, may differ a great deal in size and arrangement. On the other hand, values, such as interest, sinking fund, consumption and cost of power, depend very decidedly on the impressions and tendencies of the engineer who makes the comparison.

An important error crept into the same report in the criticism of inclined planes through the that fact only planes for a single tank were considered. Such planes are, moreover, faulty from the economic point of view. On the other hand, planes with two balanced tanks have not been considered in this report,and it is just these, whose cost scarcely exceeds that of one tank planes, which offer great advantages in the matters of capacity and operating expenses. The value of such comparisons is diminished, naturally, if they be incomplete and consider but one side. The same cost of raising water taken as the basis for calculating the locks has been adopted also for calculating flights of locks, while resting all the time on suppositions taken at random.

Taking as a basis the presence of three storage basins, and a rather too refined arrangement, with two different elevations, there is accepted, for a lock with a lift of 12 metres, a cost for raising the water used for a lockage of M 8.20, and then it is said, without specifying this calculation, that the raising of the water would cost but 2 Marks per lockage ; nothing more is said than : that in spring and autumn there is water enough in the canal to do without pumping. Then, conformably to this supposition, the reporters place the cost of raising water for a flight of locks having a total lift of 36 m., composed of three locks of 12 m. each, at M 6 instead of M 24.60.

This causes errors.

Finally the cost of service and maintenance of vertical lifts, based on the one at Henrichenburg, is placed at 50,000 marks a year, whereas at Henrichenburg it is only 20,000 marks. This may arise from the fact that there has been added, outside of

the cost of operating and maintenance required at Henrichenburg, 1 % of the cost price of the lift which corresponds to 26,000 marks. This is not justified because this expense does not exist. As I have abready said, such suppositions taken at random make comparative calculations inexact and give but a false idea of the plants.

In making a just comparison between flights of locks and lifts, the superiority will be found on the side of the latter when it is a question of great differences of level.

I too accept the third paragraph of the general reporter which says that the inclined plane offers a possible and suitable solution when the height to be overcome is very great, that is beyond 25 to 30 metres. The preference will be given, undoubtedly, to a longitudinal plane with 2 tanks which balance each other.

It is not worth while to be impressed by proportions for the electrical equilibrium of the tanks. It is a mistake to consider electrical equilibrium as simple. It involves, in reality, additional mechanical plants which are expensive and hard to watch ; furthermore the first cost and the operating expenses are large. Mechanical equilibrium gives a safer solution, much more economical, while avoiding the carriage of large and loaded boats out of water, a mode of transportation which is not suited to navigation.

The transportation of vessels out of water should be considered as having no chance if regard be paid to the competition of flights of locks with lifts, because the consequences of transportation without water are for navigation itself as well as for the vessels and their cargoes, causes of danger, complaints and disputes without end.

I end by wishing that governments which have to decide do so by building lifts, because it is experience which makes the master and experience is progress.

Mr. Genard. — Gentlemen, there has appeared, since the Düsseldorf Congress, no fact of practical importance, so far as I am aware, which can lead us to modify extensively the conclusions voted by that Congress, as to the means of overcoming differences of height between the levels of canals.

This is not, I believe, the opinion of the honorable general reporter, Commander Crugnola ; therefore, Gentlemen, I shall

set before you the reasons which prevent me from accepting all the conclusions of his report.

When I say that no new relatively important practical fact has come up in relation to this interesting question, I am mistaken.

One has indeed appeared by the construction and putting into operation of a hydraulic lift for boats, of the same type as those already built and working at Anderton, in England ; at Les Fontinettes in France ; at La Louvière, in Belgium.

This new hydraulic lift is the one at Peterboro, Canada, about which the report presented to the Congress by Lieutenant Colonel Thomas Symons gives exact information.

From a height of 15,379 m.of the hydraulic lift at La Louvière, a height which, at the time of the Düsseldorf Congress, was the greatest overcome by a lift for boats, a leap to a height of nearly 20 metres (19.81 m. to be exact) was made for the Peterboro lift.

From the 360 tons which the boats using the Belgian lift on the Central Canal might carry, an advance was made at Peterboro, for boats built like those plying the navigable water ways of Germany, France, Holland and Belgium, to a tonnage which might reach nearly 800 tons. And so great is the practically acknowledged success of this new lift, that already there is under construction another very similar one, of the same system at all events, at Kirfield, according to what we learn from the report of Colonel Symons already mentioned.

Many projects for mechanical apparatus intended to overcome differences of level on canals have come to light, undoubtedly, since the Düsseldorf Congress.

Some are based on principles already applied to apparatus serving for the passage of boats of small tonnage ; but others are founded on new principles.

The greater part of these projects were produced at the time of the competition opened at Vienna by the Austrian Government, with a view to building a navigable highway connecting the Danube with the Oder ; but these extremely interesting projects could not be carried out, up to now, and receive the sanction of experience.

From the point of view of the present Congress, they can, I think, establish but one thing, which is that people are now thinking of building canals under entirely different conditions

from those which presided over the creation of the old navigable highways.

The future will tell us what is to be expected in practice from these interesting and ingenious projects for new apparatus.

I consider that, as a general rule, these new systems, like, for that matter, the inclined planes which have been long under study, will not be very successful for boats of heavy tonnage. In my opinion, these systems are mechanically too complicated, too weak in their parts and they would require exceeding watchfulness in the matters of attention and repairs.

Moreover, I think that canals with inclined planes will never answer for as great a traffic as could be handled by a canal with separate locks or by a canal with hydraulic lifts like those of the Anderton system.

But, be that as it may, no project for a new apparatus having been realized since the Dusseldorf Congress, I think that the resolutions voted there, or at least the first two, should stand.

Allow me to recall that the first of these resolutions is couched in these terms : —

« Locks are still the simplest and staunchest engines for overcoming differences of level on canals. Storage basins allow the consumption of water to be very sensibly reduced without any marked increase in the time of lockage. »

At bottom, Mr. Crugnola's first proposition is absolutely the same. I think that we will all agree to stand by it.

The second resolution of that Congress reads : —

2. « In the case of exceptional difference of level to be overcome in a short distance, there is for canals of heavy traffic, in flights of double locks, a very practical process where the water supply is sufficiently abundant. If the sources of supply be lacking, vertical lifts give a solution which experience has sanctioned. »

This sanction applies evidently only to the lifts of the Anderton, Les Fontinettes and La Louvière type, with conjugate tanks each borne by a central hydraulic press, or of the type of lifts on floats applied at Henrichenburg in Germany, since, at the time of that Congress, there was no lift of any other type.

Now, sundry projects for vertical lifts have come to light since the Düsseldorf Congress. Hence, it appears to me, that it is important to state clearly in the conclusions which we have to draw up, that the second resolution of that Congress

could not be and is not even now applicable to any but the lifts of the two types which I have just mentioned.

As I said before, the success of the lift newly built and put into operation at Peterboro only strengthens the last part of this conclusion in so far as it marks the practical sanction given by the results of the lifts with two conjugate tanks, each supported by a central press.

As to the third conclusion voted by the Düsseldorf Congress, I think that a slight change should be made in it to-day in order to take into consideration the ingenious projects which have appeared for carrying boats over the differences of level of canals.

This third resolution was thus worded :

3. « Inclined planes applied so far only to small boats, have been the object of ingenious propositions for vessels of heavy tonnage for inland navigation. The Congress resolves that a practical test involving the construction and operating of one of these apparatus be made so soon as possible. »

It would be enough, I think, to say :

« Inclined planes applied so far only to small boats, and various systems of lifts other than the hydraulic lifts of the Anderton type, or those resting on floats, of the type of the Henrichenburg lift, have been the object of ingenious propositions for vessels of heavy tonnage for inland navigation.

» The Congress resolves that a practical test involving the construction and operating of one of these apparatus be made so soon as possible. »

I said a moment ago, Gentlemen, that I had no great confidence in the practical results which inclined planes may give for boats of heavy tonnage, if they are to be applied to navigable highways whereon the circulation is large. I estimate that the length of the operations necessary to pass the boats over an inclined plane will always be longer than by lifts of the Peterboro type, for example. This lift, with a certain amount of perfection of details over other lifts of the same system built before it in France and Belgium, can make a complete manœuvre in 12 minutes. This includes passing two boats from one level to the other, one boat up the other down.

The choice between the different means suited to overcome differences of level in canals cannot be determined by the appli-

cation of fixed rules and accurate formulæ as would seem to be the case with the remarkable report of Mssrs. Hermann and Prussmann.

In my opinion, it is the special circumstances in which one finds oneself which alone must be allowed to determine the choice.

In the comparative studies which must be made before settling on this choice, there should be considered to-day a new element thrown well to the front in the article presented to the Congress by Principal Engineer Lefebvre of the Corps of the Ponts et Chaussées of Belgium.

This new element is the low price at which can now be had the electric energy which can be used very practically in raising at each difference of level all or part of the water used in locking.

This low price is a new element of success for the locks rather than for mechanical contrivances.

But does this mean that the latter will never more be used and that the ordinary locks or the ones with storage basins will be preferred to them?

I think not.

Mechanical contrivances have had their use limited so far to canals on which it was possible to place them without too great cost, regard being paid to the slope of the ground, and when the water supply was extremely small.

But sight may be lost of the fact that high lifts allow the levels to be made much longer.

This leads to another result which, in my opinion, is of extreme importance for the future, that of being able to increase greatly the quickness of transportation by water. I believe that the future of navigation lies in the increase of the speed at which freight can be carried.

The improvements made in locks during nearly the last five centuries, which have been conceived with a view of reducing the length of time required for passing the locks and of increasing at the same time the traffic capacity of the navigable highway, have had the secondary result of giving already a much more rapid navigation.

Mechanical traction, which is now the order of the day in several countries where inland navigation is greatly developed,

is aiming at the same end, while seeking to obtain a cheaper way of hauling boats.

The high lifts proposed for ordinary locks to be built on several projected canals or even on canals undergoing transformation, where locks of 4 or 5 metres lift are being substituted for locks of 2 or 3 metres, are equally justified by the facility presented by long levels to make navigation faster than it has been in the past.

Finally, the boating industry itself, noticing the great advantages to be obtained by the use of automotor boats is beginning to apply to ordinary boats propelling engines driven by benzine, petroleum and poor gas, giving thus a faster and more regular transportation by water.

I think that it is our duty to begin right now to prepare the navigable highways so that they shall not be, in the future, an obstacle to the realization of the hopes which the boating industry is founding on these applications, and on the quickness of transportation by water which will be its consequence.

On this greater speed depends also a better utilization of the boating plant, a better remuneration for the capital invested and, consequently, a reduction in the price of freight.

Hence it can be affirmed that the future belongs to high lifts between the levels of the canal ; and I think that on account of the difficulties to be met with, in many cases, in supplying water to the new canals with high lifts, mechanical means will have to be used rather than locks to overcome such heights.

Mr. Crugnola, in the third conclusion which he submits to our consideration, gives 25 metres as the limit of height to be allowed for vertical lifts.

It does not seem to me possible to vote such a conclusion.

Inspector General de Mas, of the Corps of the Ponts et Chaussées of France, said at the Düsseldorf Congres :

« The verical lift has stood its tests. As to knowing whether it has reached its whole power or whether it will be surpassed, he will be a rash man indeed who shall set in advance a limit to the art of the Engineer or to the power of machinery. No one would dare to maintain that the weight of 800 tons or the heights admitted to-day will not be exceeded. »

The construction of the Peterboro lift came at once to prove the truth of Mr. de Mas's words.

What will to-morrow bring forth? All previsions on this subject may be upset by circumstances of place, boldness of engineers and progress in mechanical industry.

To assign a limit to the lift which may be overcome within conditions admissible for hydraulic lifts, would be to expose oneself to making an egregious blunder.

Mr. Van Panhuys. — Gentlemen, although the time allowed to this important question is limited, I solicit your attention for a moment in order to make a few observations on Mr.Crugnola's remarkable report.

It is useless to recall how the choice between the floating lift and the inclined plane was brought about. Information about finished projects are more useful than that, already far too common, which refers only to principles. So I have taken for my report a special case, that of the question opened to competition by the Austrian Government for overcoming a height of 36 metres at Prerau in Moravia.

For such a height the competition reduces itself to inclined planes and a few systems of vertical lifts. The former called forth the objection that, when there is but a single car, going up and down without being coupled to another car, it is necessary to do all the work which is extremely large. A system of electric balance was found, using the descending motor as a dynamo for the ascending car ; but the equilibrium obtained was only partial, generally not exceeding 60 to 70 %. Coupling two machines even by electric appliances is always a bother in working.

My opinion was that the floating lift might give by itself a perfect and constant equilibrium. The project finally presented consists of a horizontal cylinder which is to hold the boat. This cylinder which is closed at both ends by gates is also the float. It can move vertically in a large covered basin filled with water ; gates in the walls of this basin give access to the levels of the canal. As the float is always submerged, like a submarine boat, it will always be, in accordance with Archimede's law, in equilibrio whether it contain a boat or not. A very small force suffices to set it in motion. The general reporter mentioned a few objections to this project : 1) the difficulty of guiding the cylinder ; 2) the difficulty of maintaining its shape

and keeping it tight when under pressure ; 3) lack of a practical example.

I answered these objections as follows :

1) There are fastened to the sides of the floating cylinder rollers working on horizontal axes, these are guided by long iron beams fastened to the walls of the basin. An articulated chain might also be added for more perfect guidance.

2) The floating cylinder has been calculated for maximum stresses of 1,000 kg. per square cm. (= 14,225 lbs per square inch) ; the change of shape will be so small that it can easily by neglected. Furthermore a cylinder of 16 metres in diameter reinforced at every metre and covered with sheet iron 21 mm. (= 53/64 in.) may inspire confidence. There will be no greater deformation than that observed on railway bridges. When the floating cylinder is at the bottom, position where it is exposed to the greatest pressure, the gate of tho lower level is opened, and the cylinder supports a pressure equal to that borne by the walls of the basin on a surface equal to that of the opening. It can be seen that the tightness is thus perfect.

3) The practical example, as the general reporter has already said, was carried out in England ; but it can be considered as a proof which does not mean much. Our project has this defect in common with a great many other lifts.

We are reminded in the general report of the remarkable fact that the first locks were built in Italy — the country of engineers — toward the end of the Middle Ages. I should like to add an observation to this. Holland, my country, has always taken a great share in the study of overcoming differences of level on canals, although the country is pretty flat ; and history tells us that already about 1,300, there was at Gouda a lock built for navigation by Mr. Domker. Inclined planes were known at that time : a goodly member of them are still to be found. Their dimensions, however, are pretty small. Gentlemen, I should like by these words to ask your sympathy for Holland where the science of hydraulics has always been so welcome.

Mr. Smrcek. — One of che most difficult problems for the engineer is to lay out a navigable canal in a hilly country. I shall say nothing of the economic importance and the utility of this or that canal; I shall only mention that navigable highways

should be so built that freight rates could be lower than those by rail. Furthermore they should be useful not only to the extreme regions of the canal but all along its course ; and comparative studies should first be made, in order to examine all possibles lines, before adopting the finally most advantageous of all.

The two questions of the water supply of the canal and the best way of overcoming great heights are among the most important.

The summit level must be lowered and the canal laid out, if possible, with a small number of levels so as to make it as inexpensive as may be.

The passage from one level to another is accomplished by lifting apparatus of some sort. It is to the interest of navigation to reduce their number, for every apparatus, of whatever system, is always an obstacle to navigation, an inconvenience in operating the canal as well as an interference with its traffic capacity.

Lifts, from the economic standpoint should not increase too much the cost of construction, operation or maintenance, and the water way should not, after the choice of a system of apparatus for raising the boats, lie too far away from towns and villages, nor be transformed into a suspended canal, with the sole object of being able to cross a great height at a given point.

As the traffic is not uniform at all times, but increases at certain seasons, means must be provided for preventing overcrowding at given points, especially by making the elevating apparatus along the canal with equal capacity for traffic.

Carrying boats out of water is not received enthusiastically by boatmen. Boats should be built simply and lightly so as to be able to travel not only on large artificial canals of great depth but also on rivers where the draught of water varies and is often very shallow. Carrying loaded boats out of water might cause their sides to work very differently from the way they do in water. This would affect their tightness and might even cause leaks if such methods were often used. Furthermore, as old and worn boats may be used on the canal as well as new boats, the lifts should answer to the needs of navigation, and let the vessels be carried in water in order to avoid serious damage.

The lift should be proof against all kinds of weather ; its working and maintenance should be simple, sure and economical.

It will often be necessary to use different kinds of lifts according to the nature of the ground. How far this may be possible without reducing the traffic capacity of the canal, I take the privilege to set it forth briefly by using my report, published and distributed to the members, as a basis. I must first of all express unbounded thanks to the Austrian Government which, with great munificence, opened in 1903 an international competition for a lift for boats, the results of which I was able to use in my report.

In oder to have a firm basis by which to judge the various systems, I prepared a regular table of the different operations which a 600-ton boat would have to undergo. I supposed that the machines were perfectly built technically and put up with the utmost care in all their details. The theoretical capacity of each of the systems was obtained by my study. The maximum effective capacity of the canal, however, when all the small irregularities and imperfections inevitable to practice are considered, will reach only 75 % of its theoretical capacity under the most favorable circumstances.

A) *Ordinary locks of 10 m. lift, with two storage basins.*

It will be assumed that all the valves, gates and capstans are worked by electricity and that the mean discharge is 25,5 cubic metres per second. This is the case with the well equipped locks of the canalized Moldau, on which, near Hoerin, perhaps the most interesting large lock on the continent, with a lift of 10 metres, has just been opened for work. Two minutes have been allowed for delay due to the utilization of the two storage basins, in conformity with direct observations made at the storage basin locks on the canal from Charleroi to Brussels. The boat is at the lock for 13 minutes, while it goes ahead 200 metres. It requires 6 minutes to fill the lock and 7 minutes for the other operations, according to the detailed calculation in my report. There is an interval of 20 minutes between consecutive boats of the same line. Finally the duration of the passage of two boats in opposite directions is 28 minutes. In the same way have been calculated the theoretical efficiency of an ordinary lock with a lift of 5 m. and that of storage basin locks up to a lift of 20 m.

Similarly the traffic capacity of various other systems of locks might be calculated, without first determining the water consumption (Wouter Cool and Van Panhuys system, Pokorny system, &c., &c.).

B) *Vertical lifts of 20 m. stroke.*

a) Lift with floats, single tank of the type of the lift for boats which works so well at Henrichenburg.

The duration of the various manœuvres as above *(A)* is 14, 20 and 30 minutes.

b) Lifts with two tanks on plungers moving together, one up and the other down, of the same type as the lifts of the Central Canal of Belgium, 14, 10 and 15 minutes, the height to be overcome, from 10 to 25 m., having almost no influence on the lenght of the passage.

C) *Railways (or inclined planes) for carrying boats.*

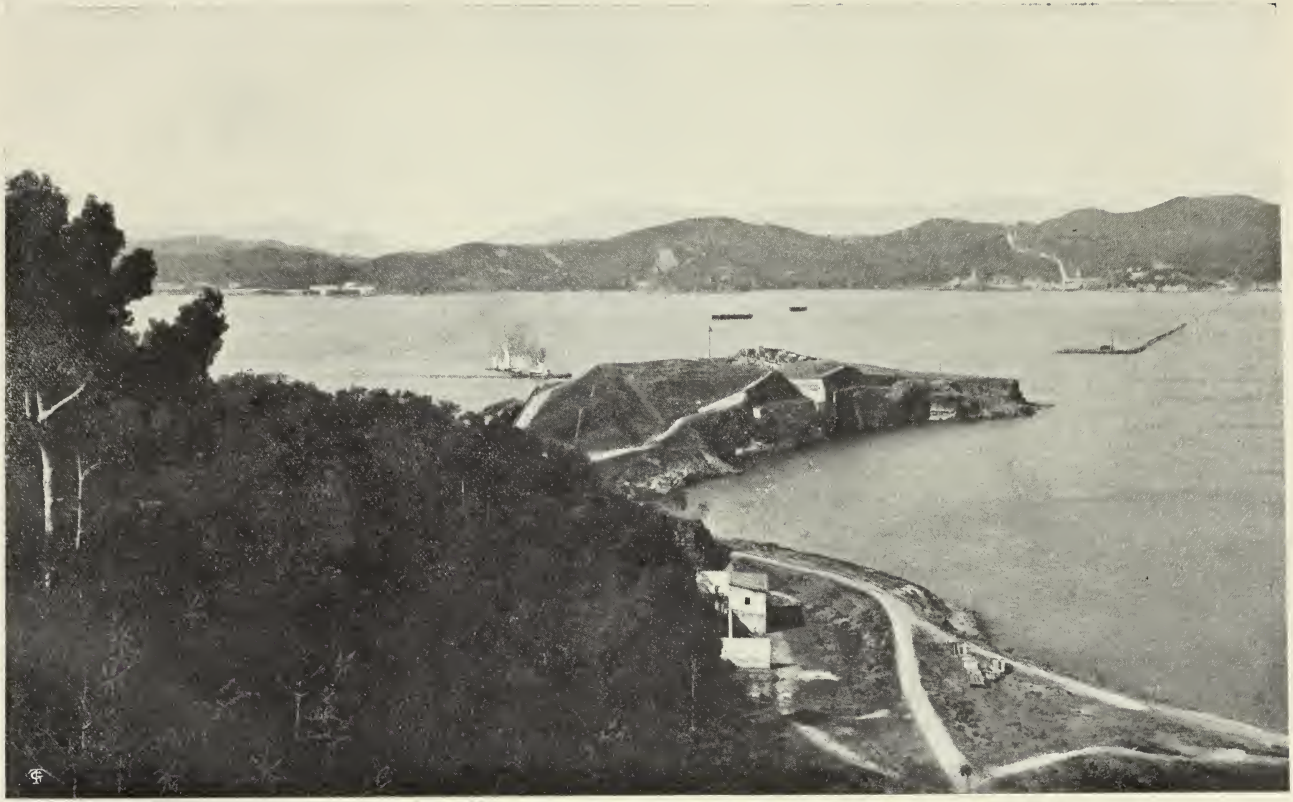
Among the few lifts of this sort built up to now for boats of small tonnage only, there should be mentioned the double track transverse plane, with a slope of 1/4 established at Foxton, England ; it has a difference of level of 22.91 m., and allows two boats going in opposite directions to pass in 15 minutes, the maximum tonnage of the boats being 70 tons.

a) Longitudinal double track planes, with a 4 % slope and a height of 40 meters. If a type be considered, uniting all the good points offered by the various projects submitted at the international competition of Vienna, the time for carrying a boat at a speed of 0.50 m., would be 52 min. 20 sec. ; and the theoretical time for passing two boats would be 47 min. 20 sec.

b) Transverse plane with a slope of 25 % with the same difference of level and average rate of speed of 0.50 m.

The time required respectively is only 18 min. 40 sec., and 38 m. 40 sec. for a plane passing a single boat ; and 18 min. 20 sec. and 19 min. 20 sec. for a two boat plane, exclusive of the loss of time required by the compensation of the floatation levels ; and without considering the difficulty there is in effecting simultaneously the respective manipulations for the two tanks which are at some distance apart.

D) *Turning or revolving lifts*, of the *Hasburg* type to which a premium was awarded. Assuming that the manipulations take place similarly to what is done with other systems of lifts, it is found that the time required, with a two boat revolving lift



Gulf of Spezzia.

and a height of 40 m., is 15 minutes for passing one boat and 20 minutes when two boats are going in oppositie directions.

Supposing a heavy traffic and assuming for navigation the most unfavorable case that can arise, that of four boats coming to the lift, three going in one direction and one in the other ; supposing further that the boats have a mean tonnage of 375 instead of 600 tons, and that operations go on during 250 days per year, the probable efficiency will be, with a service of 15 hours a day :

1. for ordinary locks of 5 m. lift for one boat Tons	5,766,000
2. for locks with two storage basins and a lift of 10 m. for a single boat	3,627,000
3. for floating lifts 20 m. rise for a single boat . .	3,586,000
4. for transverse planes for two boats, slope 25 %, 40 m. height and 0.50 m. speed	5,273,000
5. for longitudinal two boat planes, slope 4 %, 40 m. height and 0.50 m. speed	1,898,000
6. the same with 1 m. speed	2,883,000
7. the same with 3 m. speed	4,500,000

In order to prove the influence which the question of lifts may have, at the present time, on the line to be adopted for a canal, a particularly interesting example will be given, that of the proposed canal from the Danube to the Oder.

The number of locks proposed to overcome the differences of level between Vienna and Märisch-Ostrau amounts, according to the different projects, to 84 or only to 16, for which, without resorting to raising water by means of pumps, all the water required for operating, even in cases of prolonged drought, can be taken, according to the studies of the government offices, directly from the stream. It is to be observed that the entire population of Moravia which inhabits the valleys flooded by high waters, would be glad to see numerous dams built which should protect it from floods and provide at the same time against any abnormal drop of the water level.

The topography of Moravia is very unfavorable, because it forces the overcoming of the differences of level by means of short sections of canal ; solutions by means of inclined planes had to be considered.

A boat going directly from Vienna to Mährisch-Ostrau, by the use of locks, would require nearly 71 hours ; and with double-

track inclined planes, that is for two boats at a time, and a rate of motion of 1 metre, it would need only 67 hours, or 4 hours less. But this advantage of time is overbalanced by an extra cost of several millions, as I showed in my report.

A train of 5 boats drawn by mechanical traction would need 91 hours to go from Vienna to Mährisch-Ostrau, while the single boat would only need 71 hours.

Such facts as the increase of the costs of construction and operating for various mechanical lifts, and a consideration of the agricultural and industrial interests of Moravia will have a decisive importance on the solution to be adopted for the Danube-Oder canal, whether by locks or by some other system. I hope that, in order to have the canal built soon and the hydraulic regimen of Moravia systematized by dams in the valleys, the Danube-Oder canal will be built with locks and the smallest possible number of levels.

There are plenty of opportunities for making useful tests of rationally built lifts in competition with locks on many other Austrian canals where great differences of level have to be overcome and where it is much more difficult to provide a water supply for the summit level.

So, I reach the following conclusions :

1. In the matter of regularity of working, the lifts laid down on the line of a canal should have as nearly a uniform efficiency as possible.

2. The question of knowing what is the type of lift to be preferred for a canal can only be determined by a comparative study of the whole length of the line and not merely of a given point. This is necessary from the three-fold point of view of intensity of circulation, method of operating and total cost.

3. The ordinary lock which is equal to the demand of the expected traffic, is and remains the safest, the most advantageous, the most efficient and the most economical means for overcoming a difference of level even of a certain importance on the line of a canal, so long as water can be supplied to the summit level at not too great cost.

4. If water be lacking, the lift with movable tanks supported on pistons is, so far as efficiency goes, as advantageous as the ordinary lock.

Mr. Vernon-Harcourt. — The questions of the systems suited to overcoming great differences of height between the levels of a canal was discussed at the Düsseldorf Congress of 1902 ; and, in the conclusions adopted by that Congress, the wish was expressed that a practical test of an inclined plane for boats of heavy tonnage should be made so soon as possible. It is undoubtedly because of the Vienna competition and the many projects presented for overcoming a difference of level of 35.9 m. between two sections of the proposed canal to join the Oder to the Danube, at Aujezd near Prirau in Moravia, that the same question is laid before this Congress of Milan. In this competition, as at the Düsseldorf Congress, there were partisans of every system for overcoming high lifts, locks, inclined planes, elevators, although a quite uniform slope of 1 on 25 was given to the inclined plane. The Vienna jury gave the first prize to a project for an inclined plane, on which should run a car mounted on several wheels, which was to carry a tank in which a 600-ton boat was to be supported by water, and whose motion was to be provided by electric motors on the car. It may be hoped that at the assembling of the next Congress our friends, the Austrian engineers, will be able to tell us that the construction and good working of an inclined plane, for boats of heavy tonnage, has passed from the domain of speculation and become an accomplished fact. In this case, the overcoming of several other high lifts between the levels of the Danube-Oder canal by means of inclined planes will be proposed. It must be remembered that this is not the first time that an inclined plane has been talked of for boats of much greater tonnage : an American engineer, the late Mr. Eads, prepared a project, several years ago, for joining the Atlantic and Pacific Oceans by great inclined planes across the Isthmus of Tehuantepec, on which vessels of the heaviest tonnage were to be carried, instead of building the Panama Canal. So, in Nova-Scotia, a railway for vessels of 2000 tons, was begun, in 1885, across the isthmus lying between Chignecto and Green bays, 24 kilometres wide only, to avoid a difficult trip around, 800 km. long, and was nearly finished, when a refusal to extend the franchise until 1891 put a stop to the work. The Chignecto ship railway is but an inclined plane ; and if the eminent engineers who directed the Chignecto works had full confidence in the system for vessels of 2000 tons, it cannot be doubted that it will be an easy matter to

build an inclined plane over which inland navigation vessels of 600 to 800 tons can pass in perfect safety. Hence it can be said definitely that there are three systems which engineers can use for overcoming great differences of level between the levels of canals for inland navigation : inclined planes, single locks or a double flight of locks, and lifts or elevators consecrated by expérience. I tried in my report to lay down the conditions under which one system or the other should be preferred, especially in so far as the slope of the ground and the water supply were concerned. Unfortunately, several engineers, who expressed opinions at the Düsseldorf Congress and at Vienna, were partial to one system only, as the sole one which should be adopted in all cases. This, evidently, is not a scientific way of examining the question ; engineers should not take sides, but should be guided wholly by local conditions and choose in each case, after full study, the system which is best suited to the special conditions.

Mr. Lévy. — Gentlemen, after this profound discussion, the time has come to reach our conclusions. Those of our distinguished general reporter are conceived in an excellent spirit. They seem to me to be, perhaps, a little absolute in certain respects. It must be noticed first of all that since the Düsseldorf Congress, at which a resolution favorable to locks was adopted, no positive, I mean experimental, fact has come up to set aside or even to weaken that resolution. Hence it should be maintained as it was, save where it should be completed. This is what the General Reporter has done.

If I felt myself free to reformulate the Düsseldorf conclusions, I should state them in far more energetic terms. I am persuaded that locks, with lifts which they now overcome constantly, that is of 5 to 10 metres and even more in exceptional cases, with storage basins in limited numbers, of 2 to 4, with the manœuvring facilities given by electricity, with the facility, in case of necessity, of raising back water either from lock to lock or between more of less extended sections of canal with moderate reservoirs, I am persuaded, I repeat, that, with those sundry aids which the existence of a good motive power will render easy and economical for mechanical traction on the canals of the future, locks can suffice for everything, even in the most broken ground.

But we must respect the resolution of our predecessors, in the form in which they have stated it, even if it seem to us a little colorless. This is why I propose to stand by conclusion N° 1 of the General Reporter in so far as it reproduces the text of the Düsseldorf Congress.

I should propose the suppression of the first paragraph of his conclusion N° 2 in regard to fllights of locks. For truly, in the matter of locks, flights of locks are not be most highly recommended.

The second paragraph of this same conclusion is new. It advises vertical elevators up to a height of 25 m. Why 25 m. rather than any other figure? There is nothing to justify it.

Twenty metres could be understood since the Peterboro lift reaches very nearly this height. But it seems preferable, in any case, not to be too precise.

N° 3 of this conclusion is also new. The General Reporter recommends the concentration of differences of level at a small number of points and to overcome them, if these differences so concentrated exceed 25 m., by means of inclined planes.

I do not think that the Congress can subscribe to such a recommendation. It is too open to controversy.

Let it be advised, for future canals, that high lifts be adopted as having the happy consquence of diminishing the number of stops which boats have to make, the causes of crowding the water way and the disorders of every sort resulting therefrom, well and good. But in the application it is a question of kind, and, in any case, the solution is only admissible if each of the high lifts adopted can be passed in less time or during a time insensibly greater than that required to overcome the same height with smaller lifts.

Otherwise the adoption of high lifts might result not only in a loss of time for the boats, but also, and this is still more serious, a reduction of the traffic capacity, that is to say, the very utility of the canals. Now, taking this point of view which commands the whole question, may we advise now, as does the Reporter, the systematic use of inclined planes? This is what I do not believe.

I do not deny at all the technical possibility of inclined-planes for boats of 300 and even 600 t0 800 tons or more. I am convinced that the difficulties of so doing are exaggerated. The two essential difficulties which are brought up against them do

not seem to me be at all beyond the technical means of to-day. One of these difficulties, the distribution of the total weight to be moved over the numerous supports to be used, may be considered as solved by the means indicated by our regretted French colleague Peslin. It consists, as is well known, in dividing the tank into several parts connected by articulations lined with water tight and flexible linings.

If there were an inclined plane on which the slope changed frequently, some means of this sort would have to be adopted. But if the plane have only a single slope, which will be the general case, I think that this method complicates the solution needlessly, and that, under the condition of having the rolling plane thoroughly rigid, a tank with a stiff frame can be perfectly well used, save for making the girders with firmly connected spans of which it is composed, a little more flexible than is allowed for fixed works.

I even see in this solution, besides its great simplicity, the following advantage : if, when in motion, there occurred a sudden change of the water surface, there would be a corresponding modification in the loads borne by the axles. This modification would be markedly less with firmly connected axles than with independent axles.

As to the second fundamental difficulty of the inclined plane, that of keeping the boats carried from any unexpected shock while in motion, it too seems one to be easily solved, and if it had not been, the Vienna jury would not have given the first grand prize to a project for an inclined plane. Among the solutions proposed at the Vienna competition, there was one which appears very taking : it is to let the boat ground on pneus. But the two pneus of an automobile axle carry a ton between them. Hence there would be some trouble and serious difficulties of maintenance and safety with the number necessary to carry a boat of 600 to 800 tons, or even one of 300 tons. If only one part were supported by a partial settlement, there would be only partial and proportional safety. A change of the water surface alone might be enough to overload certain pneus and to burst them. Boats, too, have various shapes and it is not seen how all could ground, even on a bed of pneus.

But I think that boats can be kept in place by the help of hydraulic or hydropneumatic brakes by adopting arrangements imitated from those very remarkable and effective ones used at

the present time by the Artillery to regulate automatically the recoil of cannon at their breech. The maintenance of the water surface is perhaps more difficult. But I shall not dwell on this and I assume that an inclined plane is realized in the most satisfactory conditions. How much time will the operation require? It is at this capital point that we enter the unknown. It depends on two data which experience alone can make known definitively, viz : on the one hand, the rate of motion which it would be imprudent to exceed, on the other, the time required for handling the arrangements, whatever they be, which will serve to protect the boat and the water from a stop or a sudden acceleration, positive or negative, while in motion. I said above that I believed firmly in the possibility of guarding the boat from this danger. But, for that it must be packed, if I may so express myself, like a fragile package, and this packing, which will have to be possible, be the shape of the boat what it may, will demand a certain time which no one can foresee in advance. Here is the great unknown quantity for inclined planes. If experience should prove that this time is acceptable and does not reduce the number of boats whose passage would be possible by other means, the inclined plane will be able, under conditions in which its use is clear, (continuous slope of the ground), to render great service. Otherwise, it will avail naught.

It is because experience alone can give an answer that the General Reporter cannot now be followed in his last conclusion.

Must it be concluded from the preceding remarks that we should confine ourselves to repeating and making our own the conclusions of the Düsseldorf Congress, without adding anything thereto? By no means. The Vienna competition,come in since then, although so far it has not been followed by any practical sanction, is too important a fact to be passed over in silence, and if the hour were not so far advanced, if I did not wish above all not to weary the too long sustained attention of our eminent colleagues, I would have tried to give the philosophy of this competition, which has excited such an extraordinary and perhaps unprecedented emulation.

The President and several Members. — Go on ; we are listening with the greatest interest.

Mr. Levy. — As you allow me, I will do so very briefly.

Like all works of human progress, the Vienna competition gave birth to two sorts of solutions.

The solutions which I shall call brutal and indirect and the philosophical solutions obtained directly from the nature of things.

Between these two kinds which, since time began, have been in conflict for the possession of the world, it would seem that the first should be at once set aside and that the last should triumph all along the line. It is generally the reverse which takes place. The brutal solutions, because humanity is ready only for them, last sometimes for ages. During this time, the natural solutions are looked down on as dreams.

But suddenly one day, through the surrounding progress which, insensibly, has raised the lid of the tomb in which they have lain buried for so long, the true solutions appear and regain in an instant all the time lost.

At this very moment, and in a domain as general as, but quite other than the one now occupying our time, we are watching one of these returns of fortune in the triumphal appearance of the steam turbine, forgotten since the destruction of the library at Alexandria. Watt supplied its place by the most singular and the most unnatural solution imaginable. A uniform circular motion is desired. Watt, in order to obtain it, sets a piston travelling backward and forward in a cylinder ; to it he attaches a formidable balance beam, which communicates with his famous parallelogram, which last should give a rectilineal movement which it does not give, and which in its turn is transformed finally into a circular motion so far from uniform that an immense fly wheel has to be added to it to put some restraint on its deviations. Can anything more singular be imagined ? It is with this that Watt has led human civilization for more than a century, and scarcely do we begin to notice a decline in his reign without contrast. In the same way is there anything more brutal and more unnatural, when it is proposed to pass a boat of 300 or of 600 tons from one level of a canal to another, than to put it in a tank which weighs 1000 or 2000 tons and to raise the whole on the end of a piston, on pneus, or along an inclined plane ? One of the Vienna competitors, a partisan of locks, wittily took as the motto for his project : « Why make boats run on rails. »

For lack of something better, we must, perhaps, make them run on rails. But this solution, like that for elevators of every kind, vertical or with a circular motion, are, doubtless, only temporary or exceptional, and will give place, in the very rare case where the lock will not suit, to solutions which, for the degree of perfection which it has reached or to which it may yet arrive, will be the substitutes for the lock, and of which a few were proposed at Vienna, but considered as inapplicable now : such are the lifts with floats of various sorts, or the solution derived from the ingenious idea, enunciated in 1804 by the learned French engineer Bétancourt, of modifying the level in a lock by the immersion of a body of suitable volume placed in a basin which communicates with the lock.

I should wish that, in our conclusions, we make space for, and give encouragement to the authors of these very ingenious sorts of projects, not to be realized now perhaps, but from which may arise some day, directly or indirectly, the solution of the future.

For the preceding reasons, I think that the resolution to be voted might be stated in this way :

I. Locks are the simplest and strongest engines for overcoming differences of level in canals. Storage basins allow their consumption of water to be greatly reduced without unreasonable increase in the length of time of lockage.

Studies and tests whose object is to reduce still more this time and this consumption should be encouraged.

On this line, the Vienna competition, alongside of a large number of conceptions worthy of being thought over and of which some contain, perhaps, the elements of the solutions of the future, has brought a new and important contribution to the study of inclined planes. It would be desirable that a work of this sort, for boats of 600 to 800 tons, were built and submitted to the test of experience. This would be a trial, be its result what it might, which would render a service of the first class to the inland navigation of all countries.

Mr. Schönbach. — Remarks upon the necessity which exists, after all, of building an inclined plane for boats of heavy tonnage ; otherwise this question can receive no practical solution and will still continue to absorb the Congresses in academic discussions and personal opinions.This is the case of the reports

presented to the Xth Congress ; only those of Messrs. De Bovet, Vernon-Harcourt and Schromm take up generalities and consider the results of the International Competition of Vienna. This last has collected some very rich materials wherewith to answer, after systematically devised experiments, most questions of major importance, such as the carriage of boats in or out of water, the arrangement of the cars for carrying boats. He then proposes that the Congress add to its deliberation the wish : that the question of inclined planes to which the International Competition of Vienna has contributed largely, be settled by a soon construction of one of these works.

As to the first of the conclusions proposed by the General Reporter, he thinks it necessary to limit the advantages attributed to the use of ordinary locks.

The President, after having read the following telegram from H. E. von Budde, Prussian Royal Minister of Public Works, adjourns the session at 12.30 P. M. :

« To the Xth International Navigation Congress, I wish com-
» plete success to its works which always interest me greatly.

» von Budde,
» *Royal Prussian Minister of Works* ».

(Lively applause).

I[st] SECTION

(Inland Navigation)

III[d] SESSION

Wednesday, September 27, 1905

President :

Senator Baron Casana

The President opens the session and gives the floor to Mr. Boilève.

Mr. Boilève. — Gentlemen, as a member of the Central Committee of the Association of the Navigable South-West of France, which spreads over more than twenty departments, I have the honor and the pleasure of offering to the Bureau of the Congress the reports of the work of our first meetings, held at Bordeaux and Toulouse.

I cannot tell you how happy it makes me to find myself in the midst of a gathering of distinguished persons, composed of representatives of many Nations, come together to take part in a great work of prosperity, peace and concord, on this soil of Italy brilliant as it is with all glories, in this country of harmony which shining with all the rays starting from classical antiquity and the Renaissance, continues to cast them far forward into the future.

You know, Gentlemen, what will is required to resist the multitude of memories which crowd upon as and draw us this way and that. But here, how can we help evoking that grand figure so intimately connected with the history of the noble city of Milan, the sublime author of the Last Supper and of Joconda, the creator of the Martesana and Saint Christopher canals, the equal of Michael

Angelo, the precursor of the Laplaces and Cuviers, the artist, the poet, the man of wisdom, the engineer, the universal genius that was Leonardo da Vinci! And you will allow me, Gentlemen, to recall to you that it is at Amboise, in that beautiful Touraine where I first saw the light of day, that rest the ashes of that wonderful man whose memory hovers over this Meeting.

And this thought is common to you all : it is in the communion of such memories, it is in these sorts of sessions of civilization such as are the Congresses like this one which brings us together, that are formed and strengthened the ties which, collecting gradually more and more men, must unite all nations. So the multiplication of international congresses, scientific, artistic, economic, becomes eminently desirable.

And I add, Gentlemen, sure as I am of interpreting the sentiments of you all, that national and regional congresses should receive their inspiration from the spirit which animates the congresses of the World.

It is in this sense that those of the Navigable South-West of France have been held. Although not international, foreigners of importance, like Messrs. Brune for Russia, Romanin Jacur for Italy, Puig y Vals for Spain and the eminent General Bigotti, have sent them their works, have been warmly received by them or have been represented at them.

The fourth Congress of our Association, which will be held at Béziers, the country of the celebrated Paul Riquet, a rival of the great Leornardo, on November 24, 25 and 26 next, will follow the same course. For my part, I shall be infinitely happy to meet there members of this Congress. One can be represented there by sending communications. I hope sincerely therefore, as do all my colleagues, to note the presence of the international element, for it is there that the germ of the future union of the nations is inclosed.

The President, Senator Casana, states that the order of business presented at the preceding session could not be voted, because there was lack of agreement as to its contents. He asks Mr. Levy, therefore, to read the conclusions which he had drawn up during the interim, in accordance with one of the opponents of the preceding session, Mr. Schromm, and with the general reporter, Mr. Crugnola.

Mr. Levy. — Reads the text drawn up in French :

« The ordinary locks remain the simplest, strongest and most suitable engines for overcoming, &c... »

The text is translated into German and English.

The President. — As several of the Gentlemen ask to speak again on these conclusions, I must remind them that they were drawn up and agreed to by representatives of the different tendencies. In any event, Mr. Schromm has the floor.

Mr. Schromm. — Refering to the text prepared with Messrs. Levy and Crugnola, I shall make one single request of the meeting. I shall beg you to accept the resolutions as presented, without offering any changes which may lessen their precision. I desire that, in the text to be voted, there be contained a very clear answer to the important question which we considered at the last session, in relation to the most appropriate means for overcoming great differences of level on canals. If the Congress really desire to be of use to this great problem, it ought to vote this text without entering into the financial suitability of locks, a question which may have several solutions, according to the different countries in which it is to be put into practice.

The President. — Mr. Genard has the floor.

Mr. Genard. — I cannot accept the proposition as just read by Mr. Levy. At the Düsseldorf Congress we discussed the question then submitted to our deliberations and the conclusion as to locks then voted said simply that « locks remain the simplest and strongest engines for overcoming differences of level on canals ». Now there is added, without any reason, to the text voted three years ago, that locks are the most suitable engines for overcoming differences of level. It is evidently not possible, Gentlemen, to admit this addition, because there are circumstances in which locks are not altogether the most suitable engines for overcoming the said differences of level.

Mr. Guerreiro. — I do not agree entirely with Mr. Schromm, and I think that the words « the most suitable » can be suppressed while retaining the others, by referring to the Düsseldorf Congress, and nothing need be said of the Vienna competition.

Mr. Hermann. — Gentlemen, Mr. Prüsmann and I cannot be satisfied with the place assigned in these conclusions to the impulse which we have given to the economic importance of elevating apparatus. We are not here to discuss scientific problems in themselves; the Congress should, so to speak, give counsel and light to all Nations on the economic value of works scientifically tried.

Lifts, like all these machines in general, are first of all traffic plants, and deserve to be built only when they render effective service to trade and cause no expenses greater than commerce can bear.

An engineer can build a port on uninhabited ground. From the engineer's standpoint this port may be perfect; but if it really render no service to commerce, it is a failure; so a lift, just as excellent from the scientific standpoint, which can do nothing for commerce is not worthy of being built.

I desire to say that I had the honor of building the first float lift on the continent. The lift was constructed by the firm of Haniel und Lueg in Düsseldorf Grafenberg and I will spare no praises in speaking of this house. Later, when traffic shall be increased, we wish to build a flight of locks close by this lift. Pray believe me : only economic motives have induced us to abandon the lifts which have been technically tested. There have been but short interruptions during all the time it has been at work. The lift as such has stood a splendid test. We have had the case where the tank went dry, so that all the stresses in the apparatus came on parts for which they were not intended, or which should only be used in case of need; still the apparatus was not injured.

Then too, I wish to mention the great technical thoughts which were again called forth by the Vienna competition; but I think that the Austrian government will join to the technical appreciation of the project that of its practical and economic value.

In any case, I consider it dangerous for the Congress to advise, no matter who, to build a lift. I should have many more things to say, but I shall satisfy myself by repeating that, with the technical judgment of a lift should be also considered its economic value, that is its usefulness to commerce.

The President. — I beg the speakers to keep to the conclusions without going to the bottom of the question, and not to be too long.

Mr. De Parente. — I must make an observation in the matter of the translation of the conclusions into German; it seems to me that they correspond to closely too the French text; the translation of the French text has been made too literally. For this I ask a change in the German text.

The President. — I agree with Mr. De Parente about the translation of the French text into German.

The general reporter, Mr. Crugnola, reads in German the conclusions retouched as to form.

Mr. Lévy proposes that the conclusions be read in the different languages so as to avoid all misunderstanding.

Mr. Guerreiro. — In the conclusions offered for our approval, the opinion of the Congress is given on matters which are not general, and which may be modified by conditions of time and place. Hence, the Congress may not vote the text offered which is rather a personal opinion than a conclusion accepted by every one.

Mr. Nelemans. — While I share fully Mr. Guerreiro's views, I take the liberty of proposing à slight change in the wording of the second conclusion presented by Mr. Lévy, as it will tend to do away with the allusion made to the Vienna competition.

The first part of the second paragraph might be expressed as follows :

« There have just been published, within a short time, a large » number of very interesting conceptions ».

The President. — I must insist and cause it to be observed that questions of mere words cannot hurt any one's sensibilities.

The Vienna competition gave very good results through the many interesting studies which it called forth, and I hope that our Congress will produce results which will be equally satisfactory. I move a resolution of congratulations to the Austrian Government for the competition.

I also request Mr. Nelemans not to insist on his motion and to pass to the general vote, asking the general reporter to make in the order of business the slight modification arising from the present discussion.

Before calling for the vote, it is understood that, in the first proposition of Mr. Crugnola's report, the words « most suitable » are withdrawn, and the words « strongest and simplest » are retained.

The vote will now be taken.

It will be taken by raising the hand on the conclusions :

1° The ordinary locks remain the simplest and strongest engines for overcoming differences of level in canals. Storage basins allow their consumption of water to be greatly reduced without too great increase in the duration of the lockages.

Studies and trials, having for their object a further diminution of this duration and consumption, should be encouraged.

If the water supply is lacking, vertical lifts give a solution which has the sanction of experience.

2° The Vienna competition gave birth to a large number of very interesting conceptions. The Congress attaches the greatest importance to their being made thereof, on a large scale, an application which will allow experience, the sole judge of final resort, to pronounce upon their relative practical values, taking into consideration the speed of the boats, the traffic capacity of the canals, as well as the safety, regularity and economy of the service.

The conclusions are approved by a large majority. It is quarter past four, so the session is suspended for a few minutes.

The President states that the discussion on the second subject, the influence of the destruction of forests and the drying up of marshes on the regimen and discharge of rivers, is open, and gives the floor to the general reporter, Mr. Cipolletti.

Mr. Cipolletti. — Has the existence of forests any influence on the climate and consequently on the surrounding air? That is the first question.

The second question which comes up is this : Can the existence of forests have any influence on local vegetation? And in this case the advantages and disavantages should be studied.

Third question : Can the existence of forests contribute to the modification of springs, make the course of meteoric waters more regular, increasing the low water volume and diminishing the volume of floods?

Venice. — Entrance of the Arsenal.

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Fourth question : Can the influence of cutting down forests go so far as to cause the complete loss of springs in the denuded territory or in adjacent ground?

The questions being thus set forth and the problem of the influence of woods on the regimen of the waters being analyzed, I have sought the answers to be given to each question and now I shall try to sum them up.

The different reporters are unanimous in their conclusions as to certain questions; uncertainty exists as to others.

The first are mainly those relating to the influence which the destruction of forests may have on sloping ground.

Here we all agree.

As to the influence on springs, it may be said that here too there is unanimity of views, with differences on the subject of permeable and impermeable grounds. For the latter, all are agreed that denudation may be the cause of a diminution of springs. If it be a question of permeable ground, the majority believes that cutting down the timber does not favor the flow of the water, so that it would be favorable to the springs.

There is a great divergence of opinion on the question of the influence of woods on the climate and humidity of a region. Some think that woods have a great influence on the climate, the temperature, the humidity and consequently on the amount of rain. Others think that this influence is very small as compared with the great differences of climate.

In the last question, regarding the influence of woods on the regimen of rivers, the state of the water in the rivers should be differentiated, that is to say : is a rise or a fall considered? It may be said that all are agreed that woods have a favorable influence on rivers, because they increase the springs and keep up their discharge when the water is falling. The divergences appear when it is a question of great floods, and most of the reporters maintain that forests have absolutely no influence on the great floods of rivers. The reason they give for this is that these great inundations are only produced after very heavy rains, and that, in this case, the moderating action of forests disappears.

Nearly all are agreed in this opinion. I wish to remark that this absolute disappearance of the moderating action of forests is not absolutely true, because it is certain that when a phenomenon continues during a long period of time, all the actions which tend to moderate the influence of this phenomenon attenuate it

gradually, provided that the phenomenon have the same value during the whole of its duration, or that its force remain constant. But we know that rains have periods of maxima and minima ; for example : it will rain violently for an hour then it will quiet down. In this case the moderating action goes on all the time, as it suppresses the sharpest stage of the phenomena.

Another observation. It is true that a certain point arrives when the water coming into the forest is equal to that which goes out ; then the moderating action ceases, but it would be a question of finding out whether this takes place at the maximum of the crisis. It would be necessary to show that this moderating action disappears or becomes zero at the maximum phase. The phenomenon that I notice is not verified at the maximum of the crisis, but during the descending phase, so that a moderating value still exists.

Hence it is not exact to say that, when rains last three or four days the influence of forests is nothing ; it is nothing only for a certain period which never corresponds to the maximum crisis. So inundations will have been avoided during this maximum which is the cause of the greatest disasters.

I have divided the question into two parts : one on which, it seems to me, that we all agree, and on this point I move a vote of acceptance by the Congress. The second part is that in which the opinions of the various reporters differ; here there is nothing to do but to continue studies and observations, especially as to the influence of woods on great floods. Some have made quite minute studies to see whether, in comparing maximum floods, for example, there be any difference. But these are very difficult things, because there are too many variations in the courses of rivers, and because hydrometers are not always at the same place. In view of the enormous difficulty of being able to study the question with certitude, Mr. Lubin proposes that much more complete concerted studies be carried on between the various European states and that there be a central office where all the data shall be collected. It has been suggested that our Association be the centre of this movement ; but it seems to me that the question possesses more interest for agriculture than for hydraulics.

Furthermore we have not the means of action; I move therefore, that, accepting the fundamental idea, the International Agricultural Commission, which has its headquarters at Rome, be requested to make itself the centre of these studies and investigations. It is in

fact an international question and the Institute of Agriculture has the means of studying it better than we can ourselves. (Applause).

Mr. Joseph Wolfschuetz. — In the report of the general reporter, Messrs. Ponti and Keller, and myself are taken to task as not appreciating sufficiently the retaining force of the forest and as even denying it altogether in certain cases. Mr. Cipolletti himself thinks that this retaining force exists constantly and under all conditions. Allow me to make some objections. The influence of the wood on retaining flood waters is judged most frequently by the vegetation of the forest. In fact, such a retention of the water is observed, from 20 to 40 % of the rainfall of the year, if there be no obstacle. It is these figures which lead generally to the wood being considered an effective means of diminishing and moderating high water. But it is forgotten that these figures merely represent the averages of a long period of observations, and may be reduced to very little when the meteorological phenomenon takes place with violence and rapidity. If 100 mm. of rain fall in the course of a month, it is probable that 50 % will be retained by the vegetation ; so that only half of the rain will reach the soil of the wood, as the retaining forces of the wood can be utilized several times successively. It these 100 mm. fall in a single day, 50 % will not then be held by the wood, but only that which fixes itself in a single time on the vegetation. This quantity of water retained is so small, in comparison with the great quantity which a strong and prolonged rain can bring, that it is of no practical importance. Then the wooded ground possesses very few or even no advantages over the open ground which supports no vegetation. This difference disappears entirely when the phenomena which cause the overflow of our navigable rivers are considered. Such catastrophies are generally brought on by a very heavy general rain, lasting for several days, which reaches easily an intensity of 200 mm. a day. Already, during the first hours of an abundant rain, perhaps from the beginning of the pluvial phenomena which precede an overflow, the wood is so saturated with water that it can absorb no more and must let the superabundant water flow off just as would ground which had been entirely stripped.

Hence the wood cannot be regarded at all times and under all conditions as a means of moderating the floods in our rivers, because the moderating force of the wood is often exceeded by the intensity of the rain.

Man is powerless as against the main causes of floods, that is : meteorological phenomena, and the best forest culture can only have a limited, local and modest effectiveness even in the most favorable case. A few square kilometres more or less of forests may exercise a certain influence in countries which lie near places where forests have been replanted or cut away; but outside of these limits and along the navigable sections of the river, this influence is certainly not manifested. The carrying out of unlimited rewooding is neither feasible nor possible for economic reasons. There should exist a certain proportion between the wooded surface and the ground used for cultivation. The upper regions of our rivers may not be converted into uninhabitable virgin forests, just in order to insure to the lower country certain advantages from the point of view of economy of the waters.

On the contrary, I agree perfectly with Mr. Cipolletti if, in his conclusion, he sees the useful influence of woods in stiffening sloping ground and preventing injurious slides of materials into the valleys. There is, in fact, no simpler or surer means for strengthening and consolidating a mountainous country, for protecting it against fissures and land slides and thus preventing too great a formation of gravel, for eliminating the sanding and silting up of the navigable parts of rivers.

In this alone there are advantages of great value for the navigation of rivers. Consolidation of the ground is the most economical means for attaining this end, because no other growth than that of woods is possible on the steep slopes of mountains which are the ones most exposed to the erosive action of water. The importance of woods in this respect for our navigable rivers does not admit of discussion; but beyond this, and especially in what concerns the formation of floods, it cannot be said that it possesses any practically determinable influence.

Mr. Uzielli. — Judging by what the esteemed reporter says, it seems to me that he wishes to find a general solution for a fact which may have as many solutions as there are cases. The diversity of relations in the magnitude of the different causes which may have a greater or less influence on the amount of rainfall, makes the problem appear differently at different places. For example, when the rain-laden winds from the Mediterranean blow over Liguria and Piedmont, they drop a first portion of their moisture on the Maritime Alps which lie in just one direction as regards the higher

wind currents which carry the clouds and hurl them against the Alps. In Piedmont, the Alps do not form a chain; but a collection of mountainous groups connected with each other, and these act directly on the rainfall. Thus the Gran Paradiso acts as a condenser for the Aosta valley, which explains why the rainfall is less abundant in this valley than is the average for the rest of Piedmont. If about 60 centimetres of rain fall in this valley, the quantity of water which descends on the plain of Piedmont is about one metre. On the other hand, near Biella, a valley of which the axis lies in the direction of the southerly winds, the precipitation is very great and reaches as much as two metres a year.

It is the same in the Sesia valley which lies in the same direction.

As to the influence of the destruction of forests on the quantity of rain, it is clear that the very powerful action of the mountainous masses in Piedmont must be far more important than the more or less great influence of cutting down timber. On wide expanses of plain, as in Russia, the action of the very low hills, not counting the Oural Mountains which bound Russia on the East, is very small with respect to the action which forests may have on the greater or less quantity of water evaporated and, consequently, on successive rains. Also in Egypt, there is no question that, as the result of conditions established there, rains are not infrequent whereas in the past rain was an exception.

We see how complicated the problem is and how hard it is to find a solution applicable to all regions. I note also that in a large part of Europe, and especially in Germany, there are exact data on rainfall, on evaporation, on absorption by the soil, whereas it may be said that in Italy there are no precise data from the regional standpoint. I said regional, because I mean the average amount of water which falls on a region, or given expanse of country; in Italy, only the rainfall of this or that city is known, or these or those places where there are stations; but the amount of rain falling over a given tract of country cannot be given without a rational organization of the stations themselves.

Here is an example : From calculations which I have made and which any one can repeat, by taking the data relating to the ranges of the rivers which go out from Piedmont and enter the Po above the Ticino, and then the rain falling on Piedmont above the same point, it follows that the amount of water flowing off is five times as great as that which fell as rain. Evidently an absurd result. What is its cause? Simply this, that while there are

quantities of data for the plain of Piedmont, where the quantity of rain varies with different places, there are few stations high up on the hills, that is in the regions where the rainfall reaches a maximum.

It has been seen that, in the mountainous part of Piedmont, the quantity of rain falling on different points is very variable.

If we are to have the average rainfall of Piedmont, rain stations are necessary. In a wood, the observations are taken at places where there is the least rain, and the rainfall for the whole of Piedmont is much greater than that given in the official publications.

In order, on the other hand, to obtain the moduli of the rivers, observations are taken for three years at least at all seasons of the year; but not many are taken and almost never when the water is falling, because in this latter case artificial calculations would have to be made, at least on rivers which are nearly dry in summer, and when they are altogether dry this condition should also be taken into account. Whereas, in general, the moduli are measured when there is a certain quantity of water and from this is deduced the annual amount of run- off. It is easy to understand that the moduli of the rivers are much too large in this case, and this explains what was said above as to the rain which falls in Piedmont and the run-off by the rivers.

Mr. Lauda. — I should like to sum up briefly, and in thee time allowed, the conclusions of my report on the influence of forests on the regimen and discharge of streams.

I think, first of all that the question can only be solved by experience, by the direct comparison of the discharges in several basins which offer the greatest possible analogy in surface and orographic and climatological conditions, and differing markedly in the amount of forest land.

The Austrian hydrographic office has begun observations on this subject, for studies relating to the water supply of the Danube-Oder canal, which has allowed hydrologic researches to be made in two basins of almost equal surface, but differing greatly in forest conditions, one having 48 % of its surface covered with woods as against 27 % for the other, both basins having a total area of 70 square kilometres.

The following results were obtained :

1° The amount of water precipitated, its retention and its run-off are connected by certain laws.

2° The forest exerts, in every case, an influence on the run-off.

3° Up to a certain point, the retention of the water is greater in the more wooded basin than it is in the less.

4° In hard rains whose importance exceeds certain limits, — as for example in times of flood, — the retention becomes less intense in the more wooded basin than in the one less rich in forests ; which is to say that in this case, after having reached a certain degree of saturation, the surplus water which was retained before by the forest escapes now more rapidly.

5° After a dry season, the influence of heavy rains becomes manifest more quickly and more progressively in the less wooded basin, whereas the reverse is found in the basin which has a larger forest area.

These conclusions agree with the results of the studies obtained by the central hydrographic office, while examining the question of the influence of the forest on the formation and regimen of high flood-waters ; they are partly in opposition to the deductions of the General Reporter and with the fact, long considered as true, that the forest exerts, under all circumstances, a favorable influence on the moderation and production of flood-waters and on the rapidity with which they flow off.

A definitive judgment as to the influence of forests on the regimen of streams cannot yet be obtained, the experimental material possessed so far being too limited and referring to a relatively short period. Hence researches must still be carried on.

Were the final judgment as to the influence of forests on the regimen of streams to be found unfavorable to the forest in this sense, that some of the properties attributed to it, up to the present time in a general way, had to be disputed, it does not follow that it is necessary to be outspoken against rewooding arid surfaces and against the maintenance of forests.

The usefulness of the forest in general as well as the precious quality it possesses of protecting the soil against slips, are so certain and its advantages from the point of view of the diminution of materials scoured away by streams are so great,

that this reason alone suffices to advance the most active possible maintenance of forest culture.

Mr. Sormani. — I have to speak as President of an international agricultural Congress at Rome, and I have been asked on this account not to submit the question to the Congress, because the vote might give rise to controversies, the two interests not being always in accord. I hope for the success of both that these two Congresses will not disagree.

I find the difference which Mr. Cipolletti makes between permeable and impermeable ground very dangerous, when he says that the forests standing on impermeable soil must not be destroyed, but that they can be cut down advantgeously on permeable ground. I think that it would be better to wait for the results of science before speaking in this way.

All the soil of certain countries is permeable, and as personal interest has in life, nearly always, the better of the interests of the country, it is probable that, if the opinions of experts be asked, the experts will surely say what is agreable to private parties.

For my part, I desire to repeat that this theory of destroying forests when the soil is permeable is very dangerous.

There used to be little to fear from the waters in the province of Treviso ; but many communes have reaped great advantages from the destruction of the forests, and now others are complaining about the increase of the floods of the rivers.

Recently, only two or three months ago, there were violent storms which every one attributed to the destruction of the forests. It can be affirmed that all that is the consequence of the exploitation of timber lands by many persons, of late years, when they made large profits by so doing. Other measures will have to be taken.

Mr. Ponti observes that researches as to springs are very different. Some make them in the subsoil, seeking where the water goes, and these many studies have had no practical result; others have studied the surface water ; I prefer, for my part to treat the water at the surface where I know where it goes, rather than in the subsoil where no one knows what it does. Experiments have been made and several persons have been employed near Montello without obtaining any result.

The resolution should be modified in this that every one believes that permeable ground also needs every care.

The President. — I wish to observe that there is no absolute affirmation in the resolution.

Mr. Sormani. — I desire that the International Institute of Agriculture, which does honor to him who first thought of it and to all the countries which have become members, be able to accept the part which the Congress offers to it. I had my doubts, because it was silent at the last session, and it has accepted no engagement.

I should not wish that the Institute, engaging itself on propositions which are not universally admitted, should find it impossible to carry through what it undertakes.

Mr. Keller. — My resolution agrees on the main point with that of the general reporter : woods exist to prevent the formation and movement of land slides, and if the Congress would accept this opinion, rewooding would advance more and dewooding would be stopped.

Mr. Carpi observes that the motion proposed by M. Lauda contains nothing of a nature to affirm, on the part of the Congress, a concrete resolution on this weighty question. This motion is but a mere rhetorical form, spoken to the winds, which takes no account of the desiderata resulting from the discussion that has taken place, and which reduces the conclusions of the reporter to nothing. His opinion is that the motion of the Presidency of the Section, in accord with the reporter, is better, and answers better to a positive and practical conception of the question ; he begs the Congress to vote in favor of this motion and to decline that of Mr. Lauda.

In calling the attention of the Congress to this main factor of forest destruction, which is represented by the enormous periodical cuttings made for railway ties, he has no intention of making it the subject of a resolution. He wishes only, in the strict sense of the question submitted to the Congress, to show clearly that, as the unfavorable influence of forest destruction on the regimen of streams is recognized unanimously, special attention should be given to what is a capital cause of

forest destruction, under penalty of working blindly, that is to say of wishing to suppress consequences without seeking and attenuating the causes. He concludes by declaring that he will vote against Mr. Lauda's motion.

Mr. Lafosse.— After what has been said by the various speakers, I do not approve the too great distinction which has been made between permeable and impermeable ground, because if large forests draw away important elements from outside circulation, it is also true that these same forests afterwards return these elements to the atmosphere which surrounds them. It seems to me, therefore, that this difference, which is made and which it is pretended has been found, is only apparent.

I find too that the motion is too affirmative.

Mr. Uzielli. — I agree perfectly with the Hon. Sormani-Moretti in what he says as to putting nothing in the resolution concerning the division into permeable soils and impermeable soils. In fact, a few experiments which I have made, and of which the importance will, I believe, be considered very great by competent persons, will change the ideas held about the properties of permeable soils and of earths. For example : It was believed that clay swells when submitted to the action of water.

Wishing to measure this enlargement, I had to yield to the evidence and admit, to my great astonishment, that clay does not swell. To be brief, I shall allude to one of my experiments.

I took a tube closed at the bottom and placed in it some clay dried in the sun, then I compressed it with a wooden cylinder to give it the consistency which clay will take when exposed to atmospheric agents. Then I carefully poured water into the tube after having marked the top surface of the clay with a paper band. The clay rose, and if the tube had been opaque, the appearances of the fact would have confirmed that clay swells ; but as the tube was transparent, I noticed,after a while, that below the upper stratum of clay an air chamber had formed and was the cause of the clay at top rising. Having pierced the clay with a small tube in order to let the air escape, the clay returned to its first level.

It is useless to dwell upon the importance of this fact for constructions in general and, amongst others, for the construc-

tion of tunnels. It is notorious that the fortunes made by several railway contractors is due to damages from causes beyond their control occasioned by the advance of clay into the tunnels, destroying the temporary word linings. My experiments show that instead of trying to prevent the advance of the clay, it would only have been necessary to pierce the clay in the direction of the maximum advance in order let the air pushing the clay escape.

Then I was led to seek the cause of this phenomenon and I began a few experiments. Introducing an air gauge into the clay at the top, I found that the pressure exerted by the water which had penetrated the clay comes from capillary action and this pressure rises to more than an atmosphere. I had begun making more exact observations, when I came across an article, by the illustrious physicist Francis Jannini, published more than 40 years ago, in which the phenomena produced when permeable rocks are impregnated with water are studied. Jannini found that the capillary action produced by imbibition caused pressures reaching 3 and 4 atmospheres.

It follows from what precedes that even in permeable soils, water cannot penetrate below a certain depth, or it may happen at least that the penetration of the water will be much retarded if not altogether stopped. The conclusion is that the division between permeable and impermeable soils is something which cannot be admitted without further and repeated experiments.

It may be said in general that many observations must be made on these phenomena, I mean on all those of which I have spoken so far, observations which are especially lacking in Italy. This country has had a series of great Engineers, but most of them essentially theoreticians. Now Leonardo da Vinci said rightly : « theory is the general, experiments are the soldiers ». A general alone cannot win a battle, but soldiers can win it without the general. In other words great practice by itself is worth more than theory which is not proved by facts. I wish, on that account, that the habit prevailed in Italy in the art of the engineer of not formulating theories if they be not supported by long and repeated experiments ; and I find that, in this view of the case, only two Italians stand out : the first, Leonardo da Vinci, whom all agree to call the greatest genius the world has seen, and the other the greatest engineer who,

in my opinion, made the last century illustrious in Italy, I mean Elie Lombardini.

Mr. DE MORLOT. — The great importance of forests and their influence on the regimen of rivers are well known in Switzerland, and the legislation contains many rules concerning forests and the problems dependent upon forests. I believe that the conclusions presented are not absolutely just.

THE PRESIDENT. — In trying to sum up this very laborious discussion, I shall remark that Messrs. Lauda, Keller and de Morlot have drawn up a proposition which I am going to read.

« By reason of the great usefulness of forests in holding back » materials carried toward the rivers and in preventing the » disaggregation of the soil, the Congress resolves to protect » existing forests and give life back to those which have been » cut down. »

I must warn you, however, that Mr. Lafosse has proposed some modifications in the general conclusions, and that Mr. Ghercevanof has proposed that the question be submitted to the International Institute at Rome.

THE PRESIDENT reads the conclusions again.

Several members in differents parts of the hall rise to claim the President's attention ; many members leave the hall attracted by the first strains of the band at the Garden Party ; consequently, the Congress decides to lay the question over until the session of Friday, September 29. The President adjourns the meeting with these words :

I hope that night will bring counsel and that the agreement on the motion, which could not be had this evening, will be an accomplished fact to-morrow,when the discussion is taken up again. I thank all the members for the deference which they have had the kindness to show me, and I am sorry that other duties will prevent my having to-morrow the pleasure of presiding at our last session.

Mr. DEKING-DURA. — In the name of all the Members, whose thought I believe that I express, I offer special thanks to President Senator Casana who has directed the discussion with so much skill and courtesy.

I^st SECTION

(**Inland Navigation**)

IV^th SESSION

Friday, September 29, 1905

President :

Mr. Romanin Jacur, Deputy.

The President. — The meeting will come to order. The Chief Secretary of the Section, Mr. Valentini, has the floor, for sundry communications.

Mr. Valentini. — Mr. de Timonoff, Member of the Bureau of the International Commission, asks the bureau to communicate to the Congress :

1° The regards and regrets of Mr. Hoerschelman, who is kept in Russia by the invasion of the cholera and who sends his best compliments and wishes to the Congress.

2° The regards of Mrs Lélavski, widow of Mr. Lélavski, a Russian Engineer whose worth has been appreciated many times by the Congress ; Mrs Lélavski has had 3000 copies published of her late husband's posthumous work on rivers ; this pamphlet is at the disposition of members of the Congress.

The committee of the fourth Congress of the Navigable South-West, which will be held at Béziers on November 24, 25 and 26, 1905, begs the members of the Congress to participate in its works and offers the programme of the said Congress to all who desire it. All correspondence should be addressed to the General Secretary of the Congress, at Béziers, Allée Paul Riquet, 74.

The Association called the « Consorzio per la Navigazione Interna nella Valle Padana », offers to the members of the Con-

gress several copies of two publications, one of which contains notices on its constitution, the other its By-laws.

Colonel Carlo Porro of the General Staff, delegate from the Italian Geographical Society, sent the Permanent Commission of the International Navigation Congress a proposition for systematizing international hydrographic terminology.

The proposition is stated in the following terms :

« Before the closing of the labors of the Congress, the under-
» signed has the honor to submit the following proposition to
» the Permanent Board :

« Among the tasks which fall upon international congresses
» appears that of casting down obstacles which interfere with
» the free, complete and universal development of science, so
» that it may spread beyond the confines of States and become
» the common patrimony of Society.

» One of these obstacles is represented by the difference in
» the languages of various nations, a difference which sometimes
» makes scientific relations pretty difficult.

» This difficulty exists even when one knows different tongues,
» for all science has a technical terminology which finds no
» place in ordinary dictionaries.

» And this difficulty is still greater in the sciences relating to
» the study of topographical elements, because a large part of
» the terminology of these sciences is made up of local terms
» which vary from country to country.

» Among these sciences, must be placed the one on which we
» rest in all our studies, that is : hydrography, because, as a
» branch of the great tree of geography, it has as its main study
» the localizing of the different forms which water presents on
» the surface of the earth.

» In order to form our idea of the difficulties which may be
» encountered in international hydrographic terminology, it is
» enough to think of the great quantity of hydrographic terms
» which we know in our language, and at the same time of the
» state in which we should be if we had to translate them into
» other languages.

» So long as it is a question of general terms, as a river,
» a torrent, a canal, etc., there is, certainly, no trouble ; but diffi-
» culties appear and increase when details have to be mention-
» ed, that is to say, the elements of a stream, its regimen, its
» dykes and innumerable hydraulic works.

» For the rest, the necessity of an international technical ter-
» minology is not a new fact in science. As far back as 1888,
» two eminent geologists, Messrs. Heim and De Margerie agreed
» to arrange the French-German terminology of the shape of the
» earth, and they published this precious work with the title :
» The Dislocations of the Crust of the Earth, which gives in
» French and German the terms of the earth's morphology.
» More recently, Doctor Robert Mill, of London, proposed at
» the International Congress of Geography, the systematization
» of the international terminology for the relief of the bed of the
» sea ; this proposition which was voted unanimously has been
» carried out in French, German and English.

» In view of what has been done, the undersigned, convinced
» of the necessity for a systematization of hydrographic termino-
» logy in the principal languages, in order to obtain a more com-
» plete development of our studies, has the honor to propose
» this to the Permanent Commission of the Congress in order
» that, if this proposition deserve being considered, the Commis-
» sion may be able, before the Congress closes its labors, to
» choose the persons to whom to intrust the work which might
» be the object of a communication to the next International
» Congress. »

The President. — I think that I express the sense of the Section, by stating that the Porro proposition seems worthy of being considered ; but as the closing of the Congress is at hand, I think it preferable to transmit the Porro proposition to the Permanent Commission of the Congresses for decision.

Mr. Valentini. — I have to add another communication presented by Mr. Ghercevanof in connection with the second question discussed at the session of Wednesday evening.

The communication is as follows : —

« Being interested in the second question of Inland Naviga-
» tion of the Xth. International Congress of 1905, I take the
» liberty of saying a few words on the influence of the destruc-
» tion of forests on the regimen and discharge of rivers. »

This question arose among others, in Russia, when the railway was completed from Bologoi to Sedleze. This road crosses the region full of forests, lakes and marshes where are found the sources of our most important rivers, the Volga, the Dnieper

and the Western Dwina. The question of the preservation of the present conditions of the sources of these great highways of navigation is, therefore, of the utmost importance and fully justifies the uneasiness which is inseparable from the question of knowing what would become of the discharge of these great rivers if the region, now so rich in lakes, marshes and forests, where they rise, were dried up and stripped of vegetation by reason of the clearings which will accompany the completion of the railway. It must not be forgotten that this change, so injurious to navigation, will be the natural result of the increase of population, and that there is no use in encouraging it by this new principle proclaimed by some and discussed in the Congress, cut down the forests which do not act to preserve the waters, as it used to be believed, but which, on the contrary, dry up the ground and spoil navigation by reducing the discharge and depth of rivers. It was under these circumstances that appeared in Russia the article of Mr. Lokhtine, which was presented to the Congress and which recommends the defense of the forests and the further study of the influence of forests on the lowering of the surface of the underground waters, a circumstance which is about the only reproach laid at the door of the forests and which is, moreover, by no means supported by all the specialists. Thus it was that, during the course of this year, this same question being under discussion by the Hydrologic Council of Saint-Petersburgh and having been upheld by Messrs. Morosof and Oyssotski, in accordance with the ideas of Mr. Ototsky, encountered there an energetic opposition from a well known specialist, Mr. Nikitine, an Engineer of mines, who did not share the ideas of the others. So far as I am concerned, being absolutely a defender of forests and attaching great importance to having all possible light cast on this vital question, I agree wholly with the idea put forth by Mr. Cipolletti in his interesting report on this subject, of intrusting the further study of this important question to the International Institute of Agriculture, founded at Rome, where, there is no doubt, will be collected all the data relative to this great question which interests equally both agriculture and inland navigation.

The President. — I must recall to the Members of the Congress that the last session adjourned without the Congress being able to agree on a motion to be voted, and I must remind them

Venice. — The piazzetta.

also that there is still another proposition to be considered after having discussed this. I must appeal, therefore, to the spirit of concord and good will of all the speakers who, so far, have taken part in the discussion, in order that they may agree upon a conclusion to the second question. I therefor call upon the General Reporter, Mr. Cipolletti, to sum up the discussion.

Mr. Cipolletti. — The theme proposed by the preceding Congress was too vast and too general, as it embraced all the questions which may refer to cutting down forests, questions of climate and springs, without limiting it to what interests us and to the influence which dewooding may have on navigation: this explains the difficulty of approving the conclusions which we have reached.

All the reporters have held to the generalities of the problem as presented, and the general reporter had to follow them, thus summing up all the questions which, really, have little to do with navigation. But a sort of change took place : several Members wished to limit the attention of the Congress to that alone which interests navigation, without noticing that which relates to agriculture and thought in this way to restrict the discussion. It was under such conditions that the main discussion was begun. I desired, as reporter, that all the considerations which seemed to me to flow legitimately from the various articles presented, should be expressed in the vote. The opposition thought, on the contrary, that everything not directly interesting navigation should be set aside and wished simply to stand by the conclusions which interested navigation closely. I say this to explain what has taken place, how the conclusions set forth in my general report have been reduced to brief considerations, despoiled of everything which does not interest navigation directly.

As I do not pronounce French very well, I ask the Secretary to read, in French and in German, the conclusions agreed upon by Messrs. Keller, Lafosse, de Morlot and others.

Mr. Valentini read the conclusions in French and German.

Mr. Ghercevanof. — I should like to present a special question.

The influence of dewooding on the regimen of the waters has not been able so far to bring about any absolute conclusion.

Mr. Cipolletti's report has been well studied, so far as the articles presented by France, Austria, Belgium and other countries are concerned.

This report presents all the questions well, although it is very far from expressing a decision on these questions ; and I agree with Mr. Cipolletti to leave the care of solving this question to the International Institute of Agriculture at Rome, this being a well organized institution.

Mr. Uzielli. — I agree fully with the last speaker. But I think it necessary first to explain an apparent contradiction.

It is desired to give to an Institute founded in Italy the solution of one of the most important questions of the Congress. The International Institute of Agriculture is really of immense importance, and it can well solve the question under discussion. But this conclusion as presented has not yet been voted by the Congress, and it might be supposed, consequently, that the Congress does not approve the question which it wishes to present to this International Institute. In my opinion, this question should be submitted to the Institute only after the Congress has decided on the question by a formal vote.

Mr. Carpi. — I agree to the motion. But I notice that no account has been taken of the considerations voted at the last sessions. I should like to have a few words added about the destruction of forests.

Although I am of opinion that this question should be submitted to an Institute, I do not incline toward submitting this proposition in Italy. For my part, I think that the most suitable solution is to send it to the International Bureau of Navigation at Brussels, because all countries are there represented ; consequently it could be discussed fully and fearlessly.

Mr. Morlot. — I repeat that, although all the importance of the new Institute is well known in Switzerland, we cannot submit such a question to it.

Mr. Keller. — I am fully convinced that the results of these experiments made or to be made in most countries should be

made as already decided. I am against sending them to the Institute I do not know the Institute and I am not aware whether it will be in position to direct other countries. I propose not to accept this condition. I regret that I only know the Institute through the papers ; it may be a very fine and a very useful thing but I do not know it.

The President declares the discussion closed on the second question : « Influence of the destruction of forests and of the drying up of marshes on the regimen and discharge of streams », and puts to the vote the conclusions agreed upon by the General Reporter, Mr. Cipolletti, and Mssrs. Keller, Lafosse, Morlot, Lévy and others :

« The Congress recognizes that the influence of the drainage of marshes on the regimen of rivers may, as a rule, be nearly neglected, and, in the matter of the influence of the destruction of forests, limiting its conclusions to what may directly interest navigation, resolves :

« 1° That States which have not yet done so, regulate, by clear and severe laws, the arrangements relative to the maintenance of existing forests, to the consolidating of mountain land and to the rewooding of cleared surfaces, in order to avoid the damage done to navigable water ways by the materials carried into them.

» 2° That the hydrologic studies necessary to determine the influence of woods on the regimen of navigable streams be developed systematically and the results made kwown by the greatest publicity. »

The conclusions are approved by a majority of the votes.

The President opens the discussion on the fourth and last question : « Development of inland navigation by means of light draught boats ; their construction and their motors ». He announces that the General Reporter, Mr. Fumanti, is kept by his duties in Rome, and gives the floor to the Secretary so that he may read the conclusions of the general reporter on the fourth question.

Mr. Valentini reads the conclusions of the general report as drawn up by Mr. Fumanti on the 4th question, in French and in German.

Mr. De Bovet. — Makes some observations on the conclusions of the general report.

The question is one of inland navigation and, well stated, is a matter of interest.

The question of traction on canals has been discussed at various times and has been the cause of important reports, but this question of traction on canals has obscured the much more important one of traction on rivers in general.

It seems difficult to discuss the question of traction in general, which is completely abandoned in the Congress and cannot be taken up because too much time has been given to the reports.

I hope that this question can be properly presented to the Congress, and I ask that the question of traction on rivers in general be made part of the regular order of business in the next Congress, and not the sole question of traction on canals.

Mr. Merczyng. — Unfortunately, we have reached the end of our labors, and there still remain many things to be discussed, especially in what concerns mechanical traction. This question was under discussion at the Düsseldorf Congress where the latest results were mentioned.

Still there remain many very important questions to be discussed ; but as time is lacking, I ask that the proposition be laid over to another Congress. This question should be studied seriously and not be treated as a mere communication ; it is exceedingly important, for the subject of mechanical traction interests many countries.

Furthermore it has been seen, recently, that in Germany and in America, as Mr. Gérard has pointed out, the various Governments are much interested in the opinions of the Congress and in the resolutions taken in our discussions.

Mr. Migliardi. — I ask you to notice that the question is pretty complex, because on the one side the way of building the boats and their propelling motors must be studied, and on the other it is a question of the means best adapted to hauling boats in inland navigation. It cannot be denied that the problem is vast. However I agree completely with what has been said by the preceding speakers.

Mr. Guerreiro. — I accept the propositions laid before us ; but I am of the opinion that this question, in so far as it relates to electric and mechanical traction as well as to the shape of the boats on rivers and canals, should form part of the order of business of the next Congress.

It is, I believe, impossible to discuss it at once, and every one agrees on that.

Mr. Lévy. — It would be extremely interesting to discuss the question of the traction of boats, which would deserve, also, being assigned to a permanent Commission. It possesses too great importance and interest to be studied in a time so short as that which we have at our disposal.

My opinion is that these two questions can be discussed together, the one the mechanical traction of boats, the other on the form of the boats, without one interfering with the other.

But I think that now we can do but one thing : propose to transmit this question to the permanent Association in order that the latter may examine it and place it in the order of business of the next Congress ; that will dispense with our discussing, without sufficient preparation, the grave problem which is the object of so many communications made on this subject.

Mr. Merczyng has just told us that very important results have been obtained from tests recently made. This is true, experiments in mechanical traction have been made, but, later than these, experiments have taken place in electrical traction, and these latter should themselves be discussed, because the service of electric traction is now one of great interest.

I call to mind, also, that it is in France that all these experiments were begun and carried far forward.

Mr. Merczyng. — I must say in reply to Mr. Lévy that I have not failed to keep abreast with the recent advance of electric traction.

I am well acquainted also with the celebrated works he has himself carried on, because I have had the honor of visiting them; I have admired them and found them extremely interesting.

Mr. Lévy. — It is only the question of the development of traction in inland navigation which needs to be brought up for

discussion at the next Congress, by presenting there the results of the development of mechanical traction in general, as well as that of electric traction ; but because this question is inseparable from the question of the form of boats, which is also one of wide range, I believe that it too should be submitted to the next Congress along with that of traction.

I agree then that the question of the mechanical traction of boats in general, together with the question of the form of the boats, should be borne in the order of business of the next Congress.

Mr. Sympher. — I think it useful that the two reporters reconcile their conclusions and that the question be treated more in the way proposed by Mr. Merczyng. We have made such strides in Germany and in America that it is useless to pretend that the next Congress should take up the entire question. There are, in my opinion, quite enough materials relating to the mechanical traction of boats recommended by Mr. Merczyng.

We accept the proposition, in which we insert a few words by Mr. De Bovet.

The session is suspended for a moment to allow an agreement to be reached among the various speakers as to the conclusion relating to the fourth question.

The session is resumed.

Mr. Merczyng reads, in French and in German, the motion prepared during the recess.

The President. — In declaring the discussion closed, I call for a vote on the conclusion, but I first ask the Chief Secretary to read it as it has been drawn up by agreement among the speakers.

Mr. Valentini reads the conclusion in French and German :

« The Congress, considering the remarkable works published by the Association on the form and traction of boats running on lines of inland navigation and the prime importance of the question attaching thereto,resolves that the next Congress insert in its order of business as a question : the mechanical traction

of boats, and secondarily the study of the forms and the utilization of light draft boats. »

The conclusion is adopted.

The President. — The discussion of the questions being finished, we may, under the terms of the by laws, take up the reading of a few communications, and, if the Congress approve, the proposition to open the discussion on the communication : « As to mortgages on boats intended for inland navigation » will be presented by Mr. Montù.

The Congress having approved the proposal, the President gives the floor to Senator Frola to treat this communication.

Mr. Frola. — This very important question has been considered in connection with Messrs. Kisker, De Sanctis and other speakers, and we have the general report of Mr. Berlingieri. The greater part of the conclusions proposed were accepted in this general report. These conclusions were accepted and,with Messrs. Kisker and De Sanctis, we have the honor to ask the Congress to be allowed to lay before it a resolution in the following terms (read in French and German) :

« The Xth International Navigation Congress accepts the resolution of the Amsterdam Conference in regard to uniformity of legislation in the matter of maritime mortgages and resolves that the institution of river mortgages, that is : mortgages on vessels engaged in inland navigation, be found in all legislation and that it be improved in those where it exists already.

» It directs the Permanent Office of our Association to take the necessary steps toward the International Maritime Committee of Antwerp to have appointed on the Commission to be named by this Committee members of our Association so that the latter may extend its arms over the river mortgage. »

Finally, on motion of Mr. Crugnola, the Congress accepts the discussion of the communication : « Results obtained by dredging on the bars of rivers. »

Mr. Sassi delegated by the General Reporter, Mr. Tornani who was absent, tells the Congress about the experiments in dredging carried on by the Government on the Po during the last half of 1904.

After having given some very interesting information on the favorable results obtained, having brought out the good which dredging can do to navigation on navigable rivers in general, and set forth the importance of the question of dredging not only on the Po but also on all the rivers of foreign countries and especially on those of Germany, he offers, in the name of the General Reporter, Mr. Tornani, the following motion :

« That, as a consequence of the good results of the dredging done on the Po under the care and at the cost of the Italian Government in 1904, the Government itself purchase at once or, at least, employ two or three dredges for the urgent needs of navigation on this river. »

The President calls for the vote on the motion. It is carried.

The President announces that Mr. Sympher has expressed the wish to have the communication : « On the electric traction of boats » brought up for discussion.

Mr. De Bovet. — The question is very important ; but it is nearly noon and it would be well to end these discussions. It seems to me that we run the risk of making, on very grave and important matters, statements which could be easily disputed ; but as it would be quite impossible to discuss them on account of the little time left, it would be well to remit the question to another Congress.

The President. — By reason of the time of day, it would be well to adopt Mr. Bovet's proposition, that this important subject be put off to another Congress.

The Section decides in favor of putting off.

Mr. Sympher. — My opinion is that it is dangerous to publish deliberations on communications, because, as a rule, the means do not exist beforehand to obtain full information and carefully to study the questions.

I believe that no conclusions should be formed as to that which is but imperfectly understood and that nothing more should be

done than take note of the various communications without submitting them to a vote.

The President. — As I have the honor to preside over the session in which the Congress ends its labors, I trust that I may be allowed to say a few words before we adjourn.

In examining what has been done by preceding Congresses, it seems to me that the one which is now coming to an end has been neither less important, nor less remarkable, nor less numerous than those which have gone before.

Gentlemen and foreigners, when coming into Italy you have been received with joy, and Italy is very much honored by your visit. But, as President of the First Section, my duty is to remind you that you have as yet seen no recent work which can be compared with any of the works done in your countries for inland navigation. Gentlemen, as our President General, Senator Colombo, and our Minister of Public Works said so well at the opening of the Congress, you must take into account that Italy is a young country, not yet 50 years old, which has had to think of reorganizing its railways and seaports, which, finally, has made pecuniary sacrifices which few other countries could have borne as she has done.

I wish that from your works and from the conclusions which you have adopted at the present session, Italy may draw forth a note of encouragement for the intention which she displays in desiring to undertake the systematizing of her canals and rivers. I am sure that if Italy starts out on this line, — and there are good omens for this, because, from the young King, who has taken the lead in the scientific and economic movement, to every one who thinks and feels, we are all agreed on this subject, — we are confident and certain that, at a not far distant time, if you have the opportunity to organize a new Congress in Italy,you will find that this Italy, which has to day no work recently done to exhibit on her rivers and canals, will show herself worthy of her destinies and will place before you works worthy to appear either alongside of those of her old masters or of those which the most civilized countries of Europe have already built for inland navigation.

I thank you for your courtesy in the name of all my colleagues of Italy who join me in this cry : « Hurrah for Italy, hur-

rah for the foreigners who have honored her by their presence ! » (Applause).

Mr. Sympher. — We have reached in our Section the end of our discussions. The gratitude which all the members feel for the kindly welcome they have received in Italy will be expressed elsewhere. We do our duty in expressing our sincere thanks to our two Presidents.

The discussions of this Congress have been extraordinarily difficult. There have been many pros and cons for each question. The various opinions had to be melted into conclusions which were developed often with great trouble. But nothing could have been obtained if the happy direction of our two Presidents had not been able to bring all to order in the best way. So I ask you, Gentlemen, to rise and shout :

Hurrah for the Presidents of our Section ! (Applause).

II[d] SECTION

(Maritime Navigation)

I[st] SESSION

Monday, September 23, 1905

Presidents :

Comm. Ignazio Inglese, Inspector General of the Corps of Civil Engineers, at Rome.

Comm. Francesco Giuliani, Captain of the Royal Italian Navy, at Venice.

Chief Secretary :

Cavaliere Domenico Logatto, Chief Engineer of the Corps of Civil Engineers, at Leghorn.

Secretary :

Count Luiggi Cozza, Engineer of the Corps of Civil Engineers, at Rome.

The session was called to order at 2 o'clock, in a hall of the Royal Villa, Commander Inglese, Inspector General of the Corps of Civil Engineers, in the chair.

The president inaugurates the labors of the Section by the following address :

Before beginning our work, let me offer you my fraternal welcome and make a wish. — Fraternal welcome, because the object at which we aim is the same, for us all, and because this

object — that is facility and economy of transportation — is the first step toward the fraternity of nations. — Very sincere wish, that our labors may profit our common interests and the interests of our respective countries, by bringing them to reach the greatest possible utility in their expenses for harbor works, whose importance has always been great and is steadily growing as the needs of civilization continue to increase. For if canals, railways, roads, are the arteries whence flows the life-giving blood of nations, the seaports represent other organs which concern communications between these latter and justify the aphorism of this celebrated line of Pope :

« The seas but join the nations they divide ».

Our section has to take up a few of these organs and their relations to each other, the means of supplying them, that is : ships. — Ships, ports, canals, railways form a harmonious whole which has to be learnedly organized by engineers and administrators, because a port cannot be imagined without communications toward the interior proportioned to the intensity of the traffic in the port itself.

This is the first time that such a choice assemblage of maritime engineers and persons interested in maritime questions has ever taken place in Italy to discuss seaports and to visit our ocean works.

Our country does not yet count a half century of national existence, so, you must not be astonished at not finding in our ports all those modern resources which you have applied so widely and so well in your own countries.

Again, our very geographic configuration thrusts upon us great expenses whenever lines of communication or sea ports have to be undertaken

As to the latter, nearly all our ports are artificial, built on coasts more or less exposed, which require to be sheltered by very costly works very hard to carry out. It also happens at times that, in order to protect quite a limited water surface of small depth, breakwaters have to be built in very great depths. And if the slope of the beach be light, there are other and not less serious difficulties to be overcome, because it becomes necessary to extend the jetties beyond a certain limit in order

not to run the risk of seeing the port converted into a strand, or, at least, to spend every year enormous sums in dredging for its maintenance.

You will see that in order to shelter the port of Genoa relatively well, colossal works like the Galliera breakwater, which is 1500 metres long and placed in water varying from 15 to 25 metres deep, had to be constructed. You will see the Naples breakwater, of which the head is now on the bottom at 30 metres below the surface of the water, and you will appreciate the enormous difficulties which we must face in order to assert our dominion over the sea.

On account of all these difficulties and the necessity which we feel in Italy to solve the question of ports, we find the questions laid before this Section to be very interesting and their study, intrusted to the science of the very distinguished *savants* here present, and to the ardent interest of us all, will surely contribute to the formation of the single Code wherein maritime Engineers will delve the rules which must guide them in the preparation of projects and in the carrying out of works.

The questions which are to be discussed by this Section relate not only to the technicalities but also to the administration of Ports.

A port is an industrial establishment whose principal object is to load and unload freight at the greatest possible speed and the least possible cost ; and this is the more urgent as the tonnage of ships increases constantly, and as delays can be less tolerated, by reason of the enormous capital which lies unproductive.

Furthermore, freight coming by sea must be sent on to destination as quickly as possible, that coming from the interior to be sent abroad must find sheds ready to receive it until the moment when it can be loaded on the vessel which carries it over seas.

Hence arises the necessity for a clear-headed administration, providing for the satisfaction of all these demands, and able to give precedence to common interests over small local requirements. So, while tho 1st, 2d and 4th questions relate to the improvement of the mouths of rivers, to the progress of the methods of propelling ships and of their consequences considered from the point of view of canals and ports ; to systems of construction of defensive works against the sea in relation to

the strength of waves, the 3d question relates just to the sundry systems of administration of ports and to the influence of these systems on the development of trade.

I wish very earnestly that, in the discussions which are about to begin, we may be guided by the impartial examination of facts and by the desire to contribute, each of us to the well-being of our countries, and all of us together to the welfare of humanity *(lively applause)*.

The President then asks the meeting to retain as vice-presidents and secretaries the persons named in the Guide to the Congress :

Foreign Vice-Presidents :

BELGIUM. — Julien Troost, Honorary Director General of the Ponts et Chaussées.

Julien Nyssens-Hart, Honorary Chief Engineer of the Ponts et Chaussées.

GERMANY. — Albert von Doemming, Oberbaudirektor.

Friedrich Bubendey, Geheimer Baurat Wasserbau Direktor.

FRANCE. — Lecreulx-Mengin, Inspector General of the Ponts et Chaussées.

Guinard, Inspector General of the Ponts et Chaussées, Director of the National School of the Ponts et Chaussées.

UNITED STATES. — Elmer Lawrence Corthell, Engineer.

RUSSIA. — Paul Tchekhovitch, Engineer of Lines of Communication.

JAPAN. — Uchida Kachichi, Director of the Merchant Marine Office at Tokio.

HOLLAND. — G.-J. De Jongh, Chief Engineer of the Waterstaat.

PORTUGAL. — Comaca Jean Costa, Chief Engineer.

HUNGARY. — Louis Hoszpotzky, Engineer Councillor of Section in the Royal Ministry of Commerce.

DENMARK. — Cristien Otterstrom, Director of the Danish Maritime Works.

ENGLAND. — F.-L. Vernon-Harcourt, Civil Engineer.

Foreign Secretaries :

BELGIUM. — Pierrej Van der Schueren, Principal Engineer of the Ponts et Chaussées.

GERMANY. — Dr Rösing, Syndic of the Chamber of Commerce at Bremen.

FRANCE. — Bourgougnon, Chief Engineer of the Ponts et Chaussées.

UNITED STATES. — Lieut. Col. Thos. W. Symons, Corps of Engineers, U.-S. Army.

RUSSIA. — Prince Chakhowki.

HOLLAND. — H. Wartmann, Engineer of the Waterstaat.

PORTUGAL. — Emmanuel Roldau, Chief Engineer of Mines.

HUNGARY. — Kahnan De Kennessay, Royal Councillor, Inspector General of Railways and Navigation.

SPAIN. — Don Jules Valdes y Hamaran, Sub-Director of the Works at the port of Barcelona.

ARGENTINE REPUBLIC. — Beltram Besson, Lieutenant of the Navy.

This proposition having been adopted unanimously the President asked these gentlemen to take their seats at the presidential table.

Mssrs. Mengin-Lecreulx, von Doemming, Germelmann, Nyssens-Hart took their places ; Mr. Bourgougnon was at the Secretaries table.

The President opened the discussion on the question for the day : The Improvement of the Mouths « of Rivers flowing into Tideless Seas » and gave the floor to the General Reporter, Professor Turazza.

The Secretary, Mr. Bourgougnon, read in French the following conclusions of the General Reporter :

As has been said already, there follow from the short summaries which precede two very different tendencies in regard to the solution of the very difficult problem of the mouths of rivers in seas of small tides, one finding this solution in the construction of permanent works, the other in deepening by dredging.

Whereas, by works for increasing the depth associated with permanent works, the precarious condition which is now the greatest defect of ports having a channel leading thereto, can only be perpetuated, a return has been made to the idea of permanent works so arranged that the combined action of the river current, of waves and of shore currents, may cause the end sought to be reached.

The considerations set forth above on the proposition of Commandant Cialdi, the learned discussion and the conclusions, in this connection, presented by Professor Bruno, cause serious hopes to be founded on the results which may be reached by the adoption of funnel-shaped jetties, so, for this reason, the conclusions *A*) *C*) of Professor Bruno are perfectly acceptable. But, whereas he appears in the second paragraph of conclusion *D)* to intend to arrange on the windward jetty a series of rectangular returns with successive openings, and whereas it is believed that such an arrangement would reduce the action of the funnel which is intended to reënforce the energy of the incoming wave, the opinion is given that it were preferable to retain as a whole what has been proposed by Commandant Cialdi and to change, along these lines, Professor Bruno's conclusion *D*).

In view, finally, of the ineffectiveness of open jetties, due especially to the spreading of the wave, there seems to be no reason for recommending their use.

But, whereas also it would be necessary to wait for many years before obtaining definite results which would allow the determination of the conditions of complete success by commandant Cialdi's method, years during which other means for improving the mouths of rivers would have to brought into play ; and whereas the results obtained by dredging so strongly set forth by Professor De Timonoff and Mr. Germelmann, and used by Mr. Tchekhovitch for the Kilia mouth, it is thought unhesitatingly that all of Professor De Timonoff's conclusions, save the first, may be submitted for discussion, as may be also those of Mr. Germelmann which complete the others. So, the following propositions will be submitted for discussion :

1. (See *A*, Mr. Bruno's report). The channel of the mouth should be prolonged, at its sea end, by curved jetties of long radius, so that the outlet shall offer the most favorable direction

The murazzi of the lagoon of Venice

to avoid the entrance of deep water waves and of waves driving toward the shore under the action of prevailing winds.

2. (See *B*, do.). The width of the artificial channel obtained by the jetties should be equal to the width of the natural bed of the mouth above ; it should then increase gradually toward the sea, which is accomplished by jetties convex toward each other when the mouth is subjected to large ranges of tides ; in the contrary case, the width should be uniform or even be slightly reduced seawards.

3. (See *C*, do.). The natural bed will be attached to the artificial bed by banks of planks, masonry or random stone, prolonged by means of continuous dykes for a certain distance. According to the special cases, the dykes may rise above the surface of ordinary tides or remain constantly submerged, or sink gradually as they are extended. In this last case their crest will drop slowly to the level of the sea or a little below,thus giving the river floods and the waves an opportunity to spread out on either side.

4 The lee jetty will be shorter than the weather one, and this latter will have a rectangular return at the outer end so laid as to be struck by the prevailing winds. The faces of this side of the mouth should be vertical and rise at least one metre above mean tide. After leaving an open space beyond the return, while following the same direction, the lee jetty will be extended for a length not less than that of the return, provided that it rise as much above the mean level of the sea as does the latter.

5. Under present conditions, and so long as the results of commandant Cialdi's system are not definitively known, it may be thought that the method of direct digging is more rapid and economical than any other of those used to obtain the improvement of the mouth of a river in a sea where the tides are small.

6. (See Professor De Timonoff's second report). For improvement by dredging, preference should be given to the arm which offers and will continue to offer for a sufficient length of time the greatest advantages for navigation, by reason of its natural properties, such as suitable depths between the apex of the delta and the bar, easy curves of the inner channel, sufficient width of this channel, &c. The final decision must be preceded by a preliminary study of the entire delta, covering as long a

period of time as possible and allowing the probable changes of the different arms to be foreseen, although the lack of accuracy of this study may be of infinitely less importance for the application of dredging than for that of jetties. Under the above reservations, the essential points for the arm which is to be improved by dredging are : —

a) the wetted sections and the discharge should not be much greater than the maximum required by navigation, so as not to have to struggle against a solid discharge greater than absolutely necessary ;

b) it should enter the sea at a point of the delta where the land makes out slowly ;

c) the bar in front should be as narrow as possible so that the length of the channel to be dug and maintained may be reduced to a minimum ;

d) the direction should be such as to allow the ulterior extension of the channel, in proportion as the delta advances, without the curves becoming inconvenient for navigation or incompatible with the nature of the arm improved.

The distance between the bar and the shore, which is often decisive in selecting the arm to be improved by means of jetties, is of no importance when it is a question of dredging.

7. (See 3, do. do.). Suction dredges, supplied if necessary with appliances for breaking up the ground, are the ones best suited to the opening and maintenance of channels across bars. If the bar be not exposed to too heavy and too frequent a swell, the excavated material can be carried off advantageously through discharge pipes ; otherwise the dredge should be provided with bins. Very powerful dredges should be used so as to reduce the unit cost and to have the smallest number of vessels working at the same time in the navigable channel.

8. (See 4, do. do.). In order that the draught of the water arising from the work of deepening the arm selected for improvement may not increase unduly the liquid discharge and consequently the solid discharge of this arm, it may be prudent, at the point where the adjacent arm branches off, to put in regulating works intended to maintain a settled division of the discharges. In case of necessity, the discharge of the improved arm may be reduced to a certain extent by means of such works.

9. (See 5, do. do.). As a general rule, permanent works on the bar should be avoided, for all works of this sort, acting as a

spur dyke, increase, under the action of the sea currents and waves, the total quantity of material which accumulates on the bar. But, in certain special cases, in order to prevent the quick filling up of the channel by materials brought in from the sides, it may be well, in the interest of navigation, to build a dyke on one or even on both sides of the channel. These dykes should not narrow the current in the least degree, and it is useless to raise them above the level of low water. Their position and profiles should be so chosen as to diminish so far as possible their hurtful effect, which is inevitable in any case, on the general movement of the maritime alluvia. These protecting dykes can be made most economically with the materials dredged from the channel strengthened by simple constructions and by the planting of trees and bushes.

10. (See 6, do. do.). The work of improving the month of a river by means of dredging should not be begun until after a plan of operations shall have been fully prepared and all the plant and the necessary funds to carry the enterprise to a successful end shall have been collected. Once the operations shall have been begun, they should be carried on with all possible energy in order that the volume to be removed be kept at a minimum, that the transition period be reduced, that the interest on the capital invested be not increased and that public opinion be not discouraged.

Mr. Mengin-Lecreulx. — Gentlemen, I notice that the conclusions of the General Reporter leave the mind somewhat embarrassed. On one the hand and at the beginning, he seems to condemn the system of dredging and that of permanent works as explained, as giving only precarious results, and he notes the special arrangement conceived by Commandant Cialdi. Nevertheless, observing himself that this arrangement would need the sanction of experience, he takes up Mr. De Timonoff's conclusions, at least in part, because he suppresses the first, while he adds other points which go further than Mr. Cialdi's ideas. As every one is of the opinion that these ideas need the sanction of experience, it seems that the Congress should not take them up. As to suppressing the first of Mr. De Timonoff's conclusions, I think, without going so far, that this conclusion, according to which dredging seems to be the *sole and absolute method* in the improvement of rivers, is rather too

absolute in form. This conclusion deserves, however, to be considered by the Congress and to be included among the conclusions which the Congress will adopt on the question.

Finally, I must call the attention of the Meeting to the necessity of forming, so far as possible, a connection between the conclusions of the present Congress and those of the Congress of 1892 which were formulated after the examination of a large number of excellent reports.

Professor Uzielli. — The Reporter has summed up perfectly the reports submitted to him. As a geologist, I may not enter into questions of construction ; but I have some remarks to make on the value, too absolute in my opinion, which he has set on Commandant Cialdi's work. Cialdi has rendered eminent services to marine hydraulics by his many works, but he was an enthusiast who gave a too absolute value to waves as a cause of changes along shore, while refusing any influence to the littoral current (Moto Radente) maintained by Montanari. It is evident that the construction of works at sea and especially at the mouths of rivers does not depend on one but on several unkwown quantities, that is to say : on ruling winds, prevailing winds, sea currents, movement of the waves, formation of the shore line and bottom of the sea, etc., etc.

Mr. Cialdi considers only the movement of the waves and winds. Without being engineer, I believe that work to be done at the mouth of rivers should vary often according to local conditions.

As examples of the unilateral way with which Mr. Cialdi established his conclusions, I will mention the three following proofs, which are in favor of the movement of waves.

Admiral Albini threw into the sea at a certain distance from Savona, a bag full of sand (or stones). After some time the bag was found at a certain distance. This proves the movement of waves along the bed of the sea. The second example which he gives relates to the transportation along the shore of the Mediterranean, near Suez, of the materials removed after cutting the canal and cast on the said shore. The third example is the action of the waves raised by the S. W. winds on the 2-metre cubes which used to be on the esplanade of the Cavalleggieri, at Leghorn (to-day occupied by the public garden), and which had been made by Mr. Poirel for the port of Leghorn.

Now, it is evident that the last two examples have nothing to do with the movement of waves. The movement along the shore near Suez is due to complex causes. That of the blocks at Leghorn to the shocks of waves breaking on the coast. I needed some exact data on the currents of the Gulf of Genoa, so I wrote some time ago to Captain Cattolica, Director of the Hydrographic Office of the Royal Navy at Genoa, to find out what were the best sources to consult in regard to the currents of the Mediterranean. He told me that he only knew three books which he could recommend : « The Mediterranean Sea » by Admiral Smith ; « The Winds and Currents of the Mediterranean Sea », by Captain Becker, and the Hydrographic Annals published by the Genoa Office. I found in these Annals an excellent special article by Admiral Magnaghi on the currents of the Bosphorus, and another article, by an author whose name I cannot recall for the moment, on the currents of the Strait of Messina. Another officer of high rank in the Navy advised me to carry on some studies on my own account. I confined my self to a point which particularly interested me, that is to the coast between Spezia and Sestri Levante, I observed there during the mouths of July and August that a current set in along the coast making about 4 or 5 sea miles in 24 hours in a direction from North to South, contrary to what is generally believed, viz., that the current always runs from South to North. Evidently, when it is a question of building works to regulate the mouths of rivers, all conditions, local, meteorological, hydrographic and topographic should be considered.

I maintain that all our knowledge of the Mediterranean is very inaccurate, that local conditions vary much from point to point; consequently, that the method to be pursued in construction must vary according to local conditions and that there is no universal system of construction which is applicable everywhere.

It is important to remark that, twenty years before, Admiral, then Captain, Magnaghi, accompanied by several men of science, was placed by the Italian Government in charge of an expedition for the study of the Mediterranean, and that the observations made and the scientific materials gathered were immense, but that the Italian Government never gave the funds for publishing the results of this expedition, one of the ends of which was the study of the currents of the Mediterranean.

Mr. Uzielli repeated that he had no intention of disregarding the great services rendered by Commandant Cialdi through his work, in which he had brought together a mass of observations made by the most illutrious engineers and men of science in the world, and who has made known facts of great importance. What he reproaches him with is his having wished to solve a very complicated question in a too one-sided way.

While Professor Uzielli was speaking, the President remarked several times that the points he was developing, were hardly germane to the question.

Mr. Paolo Oblando. — I have noticed, in reading the different articles of the reporters on the question, that the conditions of seas with great tidal ranges had been considered rather than those of inland seas having very small tides; which latter I consider very important. I think that dredging at the mouths of our Mediterranean rivers is not very useful and that these mouths cannot be kept open for navigation by means of dredging. I have noticed also a defect in the conclusions of the General Reporter which I hope that the conclusions of the Congress will fill. The remedy against filling up the mouths of rivers proposed by the conclusions is : dredging or permanent works or a combination of the two systems. But I think that another and much more radical system can be adopted, which consists in avoiding the evil rather than in curing it. If the conditions of the delta be very bad, and often they have been so for centuries, as history proves, the true solution is to let navigation abandon the bed of the river which is not and never will be able to receive it. This is a thoroughly Italian solution, which was first adoptəd by he Romans at Fiumicino, at the mouth of the Tiber and which was proposed for the Rhone by the celebrated Roman « condotiero ». Vain attempts have been made for centuries to keep the mouth of this latter river open for navigation, but in the end, all the same, recourse had to be had to the Saint-Louis canal. The same thing happened on the Arno whose mouth no one has ever tried to open to navigation, and a lateral canal was built between Pisa and the port of Leghorn known by the name of the *Fosso dei Navicelli* (Ditch for small ships). I insist upon this solution being considered in the conclusions of the Congress.

I thank the General Reporter for what he has been kind enough to say about my experiments with the Working Model. But I must make some reservations. I think that these experiments are very usuful, but that, to obtain effective results, attention should be paid to reproducing, in the model, the natural conditions, because these laboratory experiments can only be, at bottom, a reproduction in miniature of what happens in nature.

Mr. Vernon-Harcourt. — The General Reporter expresses, in his conclusions, a favorable opinion on the system of curved jetties, proposed by Mr. Cialdi, for improving the channel at the mouths of rivers in seas having little or no tide. I notice that, as in the case of rivers which form a delta, these jetties must be prolonged sooner or later, the Cialdi system has the grave defect that the jetties, although well directed at the beginning, so that the littoral currents and waves can move seaward the sediment carried by the river, lie at the end, badly for the successive curvilinear prolongations. In his second conclusion, Mr. Turazza speaks of the necessity of widening the channel between the jetties, in the case of rivers emptying into seas of great tidal oscillation, which is perfectly just; but the question at issue has nothing to do with tidal rivers. In his third conclusion, he calls attention to the advantages of parallel jetties prolonging the shores on each side of the mouth, and consequently concentrating the current on the bar opposite, with the object of producing a deepening of the outside channel; but he says in the fifth conclusion that dredging gives a quicker, surer, more effective and more economical means of improvement. Nevertheless, experience has shown that the jetty system has succeeded perfectly at the Sulina mouth of the Danube and of the South Pass of the Mississippi, and Mr. Corthell, who is present, has proposed to improve the South-West Pass, the most important of the latter river, in the same way. As to the mouths of the Rhone where the system did not give satisfactory results, I explained in my report, presented to the fifth Navigation Congress at Paris in 1892, the reasons for the lack of success. It is very true that, later on, dredging was undertaken on the Sulina bar, and also on the one in front of the South Pass of the Mississippi, in the latter case to maintain and in the case of the Sulina to increase the depths which the jetties had given; but the advance of the delta and the continual recession of the curves of constant depth in front of these mouths required later the prolongation of the jetties.

I do not think that it would be possible to make these jetties with vertical faces on the channel side, as has been proposed, because good foundations could not be had in the very fine alluvia which compose the delta and great settlements could not be avoided. Very wide and very light fascine mattresses lend themselves, on the contrary, to the foundations of these jetties.

I agree fully with Mr. Turazza's sixth conclusion, viz., that it is very important to make a thorough study of local conditions in each case before coming to any decision on the subject of works of improvement. Although the jetties have given very good and quite permanent results for the Danube and the Mississippi, there are bars undoubtedly, in front of which the depths are too small, like the mouths of the Volga, or else where the bar is too far from the shore, to make a useful employement of jetties, because of the insignificant effect which would be produced in the first case, and because of the too great cost of the jetties in the second. Dredging must be tried under such circumstances. The great advance made in the power and efficiency of dredges during the last few years, and particularly in suction dredges, has greatly facilitated this way of deepening approach channels. Dredging possesses also this great advantage, that trials can be made and their importance be increased only in accordance with needs and with available funds; still it must not be forgotten that the depths obtained require to be constantly maintained by the dredge. In case that jetties be adopted, recourse may be had to dredging to aid and hasten the deepening due to the concentration of the current, and to push the channel further forward. The success of jetties depends on the existence of a littoral current, on the excavating action of the waves across the mouth, and on the presence before the mouth of great depths into which the sediment can be deposited for a sufficiently long time without causing too soon the formation of a new bar which would be an incumbrance to navigation.

Mr. Germelmann. — Gentlemen, I have not been able, unfortunately, to read and study Mr. Turazza's general report, for I have not yet received it. If I have well understood the preceding speakers, the main question is to know whether, in order to improve the mouths of rivers flowing into seas which have little or no tide, permanent works (piers or jetties) should be built or whether the required depth should be obtained artificially. I shall go no further than to mention the experiments made in Germany

on the Baltic Sea, and deduce conclusions from them. We have on the Baltic sea four or five large rivers which have piers at their mouths. We have not been able to maintain with these piers the depths of water required by modern navigation. We have been obliged to call powerful dredges to our aid and the result of this expedient has been very great. We have been able to maintain in the Vistula, which discharges a great deal of sand, — about a million cubic metres a year — a depth of 5 metres of water, by dredging about one-fifth of this volume of sand; the other four-fifths are scoured ont by the current and deposited along the shore.

The difficulties of dredging are not so great as they appear at first glance; our experience on the Baltic is that more satisfactory results are obtained by dredging a channel than by building piers, because the actions exerted by the channel are the same as those brought into play by the piers.

As a matter of fact, the channel exercises on the flow of water in the river an attractive action, and it is in this channel that the energy of the river can be best preserved, just as well as if it were inclosed between two piers. According to the experience had on the Baltic, I believe that we could never have gotten along without dredging, whereas that is possible in many cases without piers.

Furthermore, the efficiency of our dredges has become very high and the cost of dredging per cubic metre is very low; dredges are also, in the long run, very economical machines, which authorizes their being considered as the true instruments of the future for the improvement in question. Still, as the construction of piers will continue to be adopted in certain cases, I have summed up briefly, in my report on the question, the general conclusions of the subject, in a programme which I ask leave to repeat here :

In order to obtain and maintain the mouth of a river to be used both for the flow of water and for navigation in tideless seas, it is necessary :

1° To make for this river near its mouth as direct a bed as possible with invariably permanent banks;

2° To build gradually piers connecting with the permanent banks of No. 1 and which will also be straight. In this matter, it must be borne mainly in mind that piers should not come before the sand deposits, but follow them. Exceptions to this rule can be allowed only when it is necessary that maritime traffic at the mouth

of the river be especially protected by breakwaters from dangerous winds.

3° In order to make and maintain sufficient depth on the bar, a channel corresponding to the end in view is dug by means of a sea dredge of good efficiency. Irregularities which may arise in the profile of this channel should be removed as quickly as possible, so that the out-running current may have all its power and effectiveness preserved.

Mr. von Doemming. — I think that it would be of no use in this question to formulate conclusions which might become too isolated propositions, but that it would be better merely to recapitulate the general points of the question. As, unfortunately, it has not been possible for the German members of the Congress to examine the propositions of the General Reporter, I ask that a German translation of these propositions be kindly added for these members. I ask also whether it would not be reasonable to prepare the general conclusions in a more abridged form, which would be an advantage for the interests of the Meeting.

H. E. de Timonoff. — I must first thank the honorable General Reporter, Mr. Turazza, that he has been so kind, in his general report on the improvement of the mouths of rivers emptying into tideless seas, to take as bases for his conclusions all the conclusions save the first, contained in my report on the same subject. Mr. Turazza's report is very complete and not only does it sum up the partial reports handed in on this subject, but it presents a whole giving a general theory of mouths and allowing readers to form a clear idea of this complicated question. At the same time I must object to Mr. Turazza's omission of conclusion No. 1 and as Mr. Mengin-Lecreulx has remarked, I must state without any hesitation that it is just this point of my conclusions which is the connecting link between them and the conclusions of the Congress of 1892, by pointing out the position which dredging has taken, since that year, in the question of the improvement of the mouths of rivers.

It is really my opinion, as the result of the examination of the works at the mouths of rivers carried on up to now, and as it has been shown as completely as possible in my report, that the only sure way to make and maintain, in the bed of a river emptying into a tideless sea, a channel sufficiently wide and deep to meet the demands of maritime navigation is the use of dredging. It is also

the quickest and cheapest way. Mr. Mengin-Lecreulx, in pointing out to the Meeting the omission of this conclusion by the General Reporter, thinks however that this conclusion should be considered by the Congress and find its place in the series of conclusions which the Congress will adopt on the question of the mouths of rivers. I hasten to express to Mr. Mengin-Lecreulx my lively gratitude for having called the attention of the Meeting to this point which seems to me to be one of great importance. I can only share fully his opinion on the necessity of connecting as strongly as possible the conclusion of the present Congress with those of the Congress of 1892, which were drawn up, as I explained in detail in my report, after the examination of a large number of reports coming from Messrs. Franzius, Troost, Vandervin, Corthell, Guérard, Mengin-Lecreulx, Vernon-Harcourt, Welker, and the statements made by such speakers as Messrs. Fargue, Vauthier, Laroche, in the section over which Mr. Mengin-Lecreulx himself presided.

Mr. Mengin-Lecreulx said afterward, in the observations which he made on my conclusions, that the one concerning the method by dredging, while appearing to him true and just in matter, seemed to be a little too absolute in manner. Without daring in any way to deny the justice of this observation, I shall allow myself to reply only by giving this conclusion in the shape which it has in my report ; I expressed my personal conviction, the result of long and laborious studies and of works which I had the chance to carry out. The Congress is there to adopt in its general conclusions a less absolute form which shall deserve the approval of a majority of the members.

I wish to add a few words more on the subject of the criticism of which Commandant Cialdi's method has been the object. One of the speakers who preceded me seems to have expressed, on Commandant Cialdi's ideas, opinions which I cannot share. According to him, Commandant Cialdi has rendered no service to science and his observations are of no importance. I studied Mr. Cialdi's work as soon as it was printed, and I can state positively that it deserves the whole attention of engineers even to-day. Commandant Cialdi has collected in this book the results of his studies and observations on the nature of the movements of the sea, and has opened the eyes of engineers to facts of observation which were, before then, absolutely unknown to most of them. I think that the Congress should show more kindness toward the

four conclusions of Mr. Turazza about the application of the Cialdi method. While considering that these first four conclusions of the General Reporter should not appear in the shape he has given them, I believe that the Congress could perfectly well resolve that the Cialdi method be applied so soon as possible in Italy, the land of its birth, and that this experiment be very closely watched by an Italian scientist in order to furnish to some future Congress indications obtained from the observation of facts of nature. I believe it not impossible that an experiment of this sort may give results as useful as unexpected.

In conclusion, I must say that I have found in no report presented to the present Congress on the question of mouths, or in the observations made during to-day's session, any reason to admit that the general conclusions which I reached in my report and which appear on pages 23 and 24 of the French edition, do not correspond perfectly to the question as it stands, and consequently I can only uphold these conclusions as a whole to-day in company with the General Reporter and Mr. Mengin-Lecreulx.

Mr. Audouin exhibits a system for improving the South Pass of the Mississippi by means of a « Submerged dam with automatic decantation ».

The dykes at the mouth of the South Pass of the Mississippi, constructed between 1876 and 1880, soon gave a channel 9 metres deep, thus assuring excellent conditions for navigation, even for vessels of the deepest draught.

But, as it was easy to foresee, this result could only be temporary, for the causes which had formed the bar would continue to act in the same direction and would again build it up, more or less soon, at the mouth of the jetties. The data given at various Inland Navigation Congresses show that a bar had begun to form on the prolongation of the inclosed channel and that this bar has left in front of the channel a depth of only 5 or 6 metres. There is still a pass of 9 metres but this pass is narrowed and thrown toward the East; the result is a certain difficulty for deep draught ships. Dredging a passage through this bar cannot be thought of, in spite of the power of the dredges now used, because the existence of this passage could only be absolutely precarious. This will then lead to using again the means which have already succeeded, viz., to prolonging the jetties. But here again, although the work must cost very dear, the improvement can only be temporary. In order

to obtain a permanent result, the deposit of new sand in the South Pass must be prevented.

Now it follows from private experiments made on the Loire in 1896 and 1897, that a current can be separated so that the upper strata can be directed in one direction and the lower strata in another. This principle can receive many applications, one of which would give the solution of the desiderata mentioned above.

It is well known that in a current which scours out gravel, the heavier fragments move by rolling along the bottom, while only the finest and lightest bits are carried in suspension and spread through the entire mass of the current. The greater part of the materials taken up remain in the lower strata of the stream. If, then, the lower strata of the current be prevented by any suitable arrangement from penetrating into a given arm of a stream, this arm will be protected from deposits of sand.

Suppose then that there were placed, in front of the entrance to the South Pass of the Mississippi, a vertical wall slightly oblique to the current and rising, say, 3 metres above the bottom, the lower strata of the current will be deviated progressively and thrown toward the two side arms, whither they would carry all the sand which they contain.

In order that this arrangement can be set up and act effectively as has been indicated, it is necessary first that the bottom of the bed at the point considered be low enough to let the top of the dam be placed at a sufficient depth below the lowest water level of the river to let the largest vessels go by. The current must then have a velocity and consequently a scouring force such that the sand shall have no tendency to settle, that the bottom cannot rise and hence that the submerged dam shall preserve its height of 3 metres above the bottom. These two conditions are concordant, moreover, and it is known that if they are not had naturally it is easy to bring them about by concentrating the current. The means now known, such as sloping dykes, allow this concentration of the current to be produced suitably. But it would be better to use a process founded on the principle of separating the current, a process which to which has been given the name of « Oblique Dam with suspended movable gates ».

In a word, it is a true settling basin which has been formed at the entrance to the South Pass, and the system may be called : « Submerged dam with automatic decantation ».

M. L. Corthell. — The speaker wished to know in the first place what is meant by « tideless Sea » viz., whether the term tideless is applied to seas like the Caspian or the Batlic where the tidal oscillation is but a few centimetres except in exceptional and accidental cases, or else like the sea of the Gulf of Mexico where the average tidal oscillation is 14 English inches, about 0.35 m. Mention has been made during the discussion of the works carried on in the Gulf of Mexico and of those of the Rio Grande do Sul in Brazil, where the tidal oscillation is about 60 cm., with a maximum, owing to persistent winds, of about 1.50 m. If these latter conditions and those of the Gulf of Mexico be included in the question, the spreaker cannot accept some of the proposed conclusions. So far as dredging at the mouths of rivers is concerned, when the tidal oscillation is small, as in the Gulf of Mexico and at Rio Grande do Sul, his opinion is that dredging is not necessary to make and maintain a channel across the outside bar. He gave the South Pass of the Mississipi as an example where less than one per-cent of the total volume carried away to make the channel was dredged, and that was rather to hasten the formation of the channel; and the example of Tampico at the mouth of the River Panuco where the whole volume of several millions of cubic metres was removed by the action of the current which had been strengthened by the dykes that had been built. The only dredging done there (about one-half of one per-cent of the above volume) became necessary to carry away refractory materials, viz., the remains of wrecked vessels buried in the bar. The works where finished in 1892-93, and the channel (nearly 18 feet deep, while before it was only 6 feet) has been maintained up to now without resorting to dredging. As a matter of fact, no dredging has been done during these 12 years within 500 miles of the works.

Furthermore, the bar has not advanced seaward; it has rather drawn in, although the river sometimes carries a great deal of sediment into the gulf.

The works in question (two parallel jetties 1000 feet apart which extend seawards beyond the bar and into deep water) have strengthened the littoral current, and the current due to the winds which swept to one side the materials discharged by the river. The speaker illustraded this fact by four relief models, at the Saint-Louis Exposition of 1904, which show that there is now, in front of the jetties, a greater depth of water in the sea than there was in 1889 when he projected the works.

He is so sure of the justice of his views as to the effectiveness of well directed works to cut out sea bars permanently and to maintain a channel indefinitely, that he has proposed recently to the Government of Brazil to make a channel across the very difficult bar of the Canal Norte to Rio Grande do Sul and to maintain it on the « No cure, no pay » system, that is without any pay whatever. He is perfectly confident that the two straight parallel jetties proposed will produce the desired result and that without any dredging, save perhaps what may be indispensable to remove refractory materials and to hasten the formation of the channel. He estimates that a maximum of 300 cubic metres of dredging will have to be done for 18,000,000 cubic metres which will have to be removed to obtain the maximum channel; he hopes moerevoer to avoid all dredging thanks to the action of the current.

He agrees perfectly with Prof. Timonoff on the ideas as to dredging expressed by the latter, but only in what touches the work on the upper parts of rivers, that is, above the mouths; and that on account of the draught of the water, which, on the contrary, is not applicable to the mouths where dredging can never be, in his opinion, anything but an auxiliary system.

He does not think that the channel should be widened as the sea is approached, that is the channel which lies beyond the shore line; he thinks that nothing more should be done than prolong the banks of the river beyond the bar, thus forming artificial banks by means of parallel works.

One of the reasons for which the distance between the above mentioned works should not be increased, in proportion to the advance seaward, is that these works, being made generally of rip-rap on fascines, allow the escape of a volume of water which increases as the heads of the jetties are neared; however the area of the cross section of the channel at the heads should be *at least* equal to that at the root of the jetties. He had found at the South Pass of the Mississipi a loss of 25 % of the volume of the water entering the channel, and very nearly the same figure at Tampico.

He does not believe in *low* jetties, but he thinks, on the contrary, that they should come sufficiently above the water level so as to use the strength of the current in the best way possible and to prevent the deposit in the channel of materials thrown over the jetties by the waves if the former be too low.

The speaker states that the ideas which he has expressed during the discussion are founded not on experiment, but on

the practice of all his life spent in the construction of very important and very successful works. This practice has enabled him to acquire very clear opinions on the question, and he could not consent to the adoption by the Congress of conclusions which he considered as erroneous.

Mr. Luiggi. — I believe that the divergence between the opinions expressed by Mr. Germelmann about the non-success of the jetties at the Baltic ports, and those of Mr. Corthell about the success of the jetties at Gulf of Mexico ports — to which latter corresponds, in Italy, the quite complete success of the jetties of the ports of Malamocco and Lido at Venice and of Porto Corsini at Ravenna — may be considered as only apparent. I think that, after all, the different results obtained are due to radical differences in local conditions ; if these conditions had been the same, the results would have been the same in all these cases.

It would be necessary, for example, to know the depth of the sea at the heads of the jetties of the Baltic ports, to see whether these heads lie within this *neutral line* which our regretted and illustrious Inspector General of Civil Engineering, Mr. Cornaglia, pointed out as separating the zone where the tendency of the waves is to cast materials on the shore from that where the waves tend to carry these materials seaward.

I am very much afraid that the heads of the jetties of the Baltic ports lie inside of the neutral line, whereas if these jetties, as in the case of the American ports and those of Lido and Malamocco at Venice, went beyond the *neutral line*, thus reaching depths where the wave action assists in carrying seaward the sediment discharged and deposited by the river, the main cause of formation of the bar would disappear.

I consider, however, that as a general rule, in order to solve the problem in question, the position of this neutral line, which depends above all on the knowledge of the waves, currents and several other conditions pointed out by Mr. Cornaglia, should be thoroughly studied.

Under these conditions, it must be seen whether the jetties would not be too long and whether they can be built economically out to the neutral line. It might happen that the cost would be so high that the application of this solution would be impossible ; in this case, simple dredging, or the combination

Naples. — Vesuvius.

of dredging and jetties, might be justified. In all countries where capital is lacking or where the rate of interest is very high, as in the Argentine Republic, India and the East Coast of Africa, this second solution of dredging might allow the improvement of the entrance to many rivers at not too great annual cost, without the initial use of a large amount of money. Furthermore, as in these countries there have not yet been made continuous studies of local conditions, the solution by dredging does not compromise the future as would be the case with jetties if these were badly laid out, for the effects would be disastrous and perhaps irreparable.

In fine, it is meet, in order to improve the mouths of rivers, to study first the application of jetties ; if this solution cannot be realized for economic reasons, recourse can be had to that by dredging or to the two systems combined.

Mr. Turazza, General Reporter. — I desire to justify the system adopted to formulate the conclusions to be discussed, according to which the proposition for permanent works is separated wholly from that for dredging. I was led to this separation because I believe that the problem could only be solved by finding the means of building durable works without needing to repeat dredgings or to add other works, after the first series of works has been finished.

As for permanent works, I agree with the preceding speaker, Chief Engineer Luiggi, that their establishment cannot be laid down in a general may for all cases, because it depends mainly on the very variable conditions of the mouths of rivers.

The system studied by Commandant Cialdi offers, however, general advantages in all cases, viz., the cleaning action in the pass between the two jetties, due to the return head of the windward jetty inclined in the direction of the ruling waves and receiving the blow of these waves at a certain angle. This action, as explained by Professor Bruno, consists in the effect of excavation and carrying away of sand by the retrograde action of the undertow. Professor Bruno says that he who assumes the opportunity for prolonging the jetties, the system generally used, cannot help admitting Mr. Cialdi's proposition, the effect of the return wall with a passage being undoubted. He recommends, however, in his conclusions the adoption of the Cialdi system.

Still, as this system, as noticed by preceding speakers, has not yet received the sanction of experience, and as many years would probably be necessary in order to test it, he admits that, as things are, the Congress can formulate no conclusions on this subject.

I recommend however the adoption of the conclusions of Messrs. GERMELMANN and DE TIMONOFF.

As to Mr. ORLANDO's proposition, relating to the cutting of a lateral canal, I must say, so far as I am concerned, that it begs the question, because the lateral canal is a work by itself, which has nothing to do with the mouth of the river ; this proposition might find a place in other conclusions.

Besides, I do not think that a lateral canal can always give very good results ; that would depend rather on the condition of the sea outside and on the movement of the waves. As, in the lateral canal, but a small part of the bank of the river can be taken in, and as only a small velocity can be allowed on account of navigation, the deposit of sediment brought down by the river might, in certain cases at least, obstruct the inlet to the canal in a short time.

Mr. ORLANDO. — I approve fully what has been said by some of those who have spoken : it cannot be stated in a general way before hand whether the preference should be given to dredging, to permanent works or to both together, but the application of the different systems should vary, in each special case, according to local conditions and especially to winds and currents.

I cannot accept the objection raised by Mr. TURAZZA condemning my proposition. We should not take our programme too literally ; in the case when mouths cannot be improved in any way, other remedies must be found, and even in other cases it might he well to study the solution by the lateral canal in comparison with the other possible solutions. I ask that my proposition be included in the conclusions of the Congress.

Mr. TURAZZA, General Reporter. — I make no objection to having Mr. ORLANDO's proposition find a place somewhere in the conclusions of the Congress ; but I insist that this proposition is not germane to the question under discussion.

Mr. NYSSENS-HART. — The opinions of the different members of the Section seem to cover the question very thoroughly. On

the one hand, some engineers expect the permanent improvement of the mouths of rivers having little or no tide from the single effect of permanent works at the entrance ; others consider that the improvement can and should be demanded from dredging carried on systematically. Finally a more complete solution has been presented : that of a lateral canal which, really, is not an improvement of the mouth of a river, but the suppression of this improvement by substituting a solution which is much to be preferred in certain cases.

The authors of proposed resolutions cannot expect that the Section, and then the Congress, will vote the rather too exclusive texts which they present. It must also be recognized that, in connection with this question, the discussion has led the speakers to mention the entrance to the port of Lido at Venice, the mouth of the Maritime Seine, &c. Both of these examples are out of place in the question of the improvement of rivers emptying into tideless seas.

The problem will come before the engineer every time with its own characteristics, and it may be said that the solution to be given is a question of kind. How great are the liquid and solid discharges of the river ; what is the movement of the shore regimen, the nature of the bottom of the sea, what are the available materials ? What, on the other hand, is the economic value of the problem ? What resources are to be had ? All these elements of the problem will be stated and studied over by the engineer who has to prepare the project ; and the solutions will probably vary with the certain data which form its special base in each case.

Hence I conclude that the Section should be on its guard against voting too absolute conclusions which will possess no value ; and I believe that there will be good grounds for preparing a text which will point out the many ways along which solutions may be sought.

The President brings to the notice of the Meeting the following telegram from the Chamber of Commerce of Leghorn, addressed to Chevalier E. Sanjust de Teulada, General Secretary of the Congress : « At the moment of the solemn inauguration of the Xth. International Navigation Congress in presence

of His Majesty the King, a general meeting of this Chamber of Congress draws from this fact the best wishes for the revival of our merchant marine, our power and our glory in the past.

Signed : ARDISSON,
President.

The PRESIDENT then said that the discussion of the first question would seem to be closed, but it really is not so, as no conclusion had been reached. Conclusions, and especially general ones such as have been asked for, are always hard to prepare. He asks the views of the Meeting as to what would best be done.

His Excellency DE TIMONOFF. — I think that the best thing to do is to appoint a special Committee of members of the Congress to take charge of preparing the conclusions.

The PRESIDENT puts this proposal to the vote. It is carried unanimously, and the President appoints the following members of the Committee : Messrs. VERNON-HARCOURT, President, CORTHELL, GERMELMANN, LUIGGI, MENGIN-LECREULX, NYSSENS-HART, ORLANDO, DE TIMONOFF, and the General Reporter Professor TURAZZA. The Committee is to present its report at the last session of the Section. — As proposed by one of its members, the Committee decides to meet immediately after the session of the Congress.

The President adjourns the session at 4. 30 P. M.

II[d] SECTION

(Maritime Navigation)

II[d] SESSION

Wednesday, September 27, 1905

President :

Captain Francesco Giuliani, of the Royal Navy, at Venice.

The President calls the meeting to order with the following address :

Gentlemen and dear Colleagues,

Allow me, before we begin the labors of this second session of the Maritime Navigation Section, to bid you welcome and to offer you my warmest regards.

By reason of the honor conferred upon me of presiding over this Section, I come as the representative among you of the numerous and hard working class of seamen to which I belong, among you whose constant task it is to provide in your countries sure shelters for us, to make easy access for us to commercial and industrial centres, and to give us quick and powerful means for carrying out the operations of exchanges which are increasing daily with feverish activity as the life and needs of society become more intense.

I trust that in future Congresses a larger share may fall to Maritime Navigation properly so called, and that a larger number of seamen may be mingled with the engineers and constructors. In this way will be realized a closer understanding between us navigators, who take advantage of the ports, mari-

time stations, means for landing and tying up, and the Engineers whose studies and talents bring to pass the astonishing works relating to the construction, the perfect working and the maintenance of these establishments and means.

The study of certain questions when made at once by engineers and seamen, will lead more quickly to satisfactory results, and our mutual understanding guided by different ideas toward common objectives, will be more profitable for the progress of civilization.

The more uniform the practice of navigation becomes, the less are to be feared the uncertainties and misunderstandings which are often disastrous, and the more promptly and effectively will be realized that assistance at sea which depends to day only on the good heart and the judgment of seamen.

Now, Gentlemen, let us go on to the discussion set for the day's business.

Vice-Admiral MARCHESE, of the Royal Italian Navy, joins in the wishes of the PRESIDENT, that a larger part of the time of future Congresses be given to maritime navigation.

The PRESIDENT reads the following telegrams from His Excellency von BUDDE, Prussian Minister of Public Works, and from H. E. the Italian Minister of Agriculture, Industry and Commerce, Prof. RAVA, addressed to Senator COLOMBO, President General of the Congress :

Senator COLOMBO. — *Milan.*

I have received your kind invitation for the Navigation Congress. Just arrived at Rome, I wish the best success for the important works of the Congress which interest me exceedingly as Minister of Commerce.

My cordial greetings. RAVA.

Senator COLOMBO. — *Milan.*

I wish complete success to the work of the Xth of the International Congresses in which I am always interested.

VON BUDDE,

Minister of Public Works in the Kingdom of Prussia

The President then gives the floor to Mr. Soliani, Engineer and General Reporter on the question : « Advance in the means » of propelling ships ; consequences from the standpoint of channels and ports ».

Mr. Soliani began by calling attention to several serious mistakes which had found their way into the French translation of his report.

He then made a résumé of his general report by illustrating it with several details taken from reports handed in to the Congress and read the following conclusions :

1° Piston engines and cylindrical marine boilers have reached such a degree of perfection that it does not seem possible that further improvements of any importance are possible.

The engines and boilers now in use are the result of improvements introduced during nearly a century and of their successive and continual adaptation to the surrounding fluid in which they work ; they now auswer, also, nearly perfectly to the many demands which they have to meet.

So far, machines and cylindrical boilers have had the exclusive Kingdom of the seas, and, by virtue of the above acquired qualities, they will continue, at least in the merchant marine, to maintain their preponderance in spite of the profound evolutions which are beginning to take place in propelling engines.

2° The cylindrical boiler has been replaced in the navy by the water-tube boiler which, it appears, will also be adopted by the merchant marine when it shall have undergone a certain selection, and become sufficiently adaptable to the conditions of the merchant marine ; a selection and adaptation which have begun to be carried into effect and will lead to the adoption for the merchant marine of a special type of water-tube boilers corresponding perfectly, in service, to the economic and practical conditions which are so well satisfied by the cylindrical boiler.

3° Steam turbines have also won laurels both in the navy and in the merchant marine, and they are beginning to compete seriously with cylinder engines. They have important advantages : simplicity, economy in weight, fuel and hands, and in the absence of vibrations.

Certain conditions necessary for their working seem, however, to limit their use, for the future, to very fast boats, but it can

be foreseen that, by reason of the advantages which they offer, they will be gradually and successively adapted to nearly all classes of vessels. It appears that it is to water-tube boilers and steam turbines that new improvements will be brought and that these will be the last step in the evolution of steam navigation.

4° New propelling apparatus have been seen to appear for some time back : gas machines and machines for liquid fuel. It is premature, perhaps, to make prophesies as to the extension of these new systems, although several precious qualities, inherent to them alone, are of a nature to attract strongly their practical application to long distance navigation.

Mr. Soliani also adds, after mentioning the somewhat conservative character of the masterly report of Mr. Lelong who likes, it seems, to keep within the limits of certain advances which have been really obtained, and the progressive character of the report of Messrs. Techel and Narten, that he confirms his own optimistic opinion, which approaches that of the latter writers in regard to the final success of the improvements in course of realization.

Although cylindrical marine boilers and marine engines with cylinders, which are the result of a half century of efforts to acclimatize them to sea service, have acquired a high degree of perfection and adaptation to the severe conditions of navigation, which it is very hard to obtain in their entirety with other means, it is none the less true that unceasing progress is being made. And as new forms of boilers (water tube boilers), of marine engines (turbine engines) present certain important advantages over the engines and boilers now in use, we may be sure of the final success of these new means which, in order to succeed, have only to undergo the same process of selection through which the rival boilers and engines have already passed ; and this success is all the more sure, as these new boilers and engines have already shown that they satisfy at least all the essential demands of navigation.

The reporter thinks that it will be the same with the marine motors without boilers (engines with direct combustion of liquid or gaseous fuel in the cylinders) which are at the dawn of their development. But in this case, the path to be passed over is much longer and more difficult on account of certain negative peculiarities of these new machines.

The difficulties to be overcome are really very serious ; gas and petroleum engines cannot be reversed, or this cannot be done without resorting to gearing which can scarcely be allowed on ships. In any event, safety of manœuvring, an essential for ships, is lacking.

The weight of this kind of machine increases enormously when a certain power is exceeded. There are,also, other capital difficulties : the rarity of fuel in the case of petroleum engines, and the difficulty of using on board any sort of coal in the case of gas machines.

Mr. Soliani brings out on this point the very great difference which exists now between the production of petroleum, and that of coal which is incomparably greater in quantity. Hence arises a grave difficulty in the development of petroleum engines at sea ; a difficulty which is increased by the fact that although the light petroleums are used successfully in small open pleasure boats, their use must not be thought of on true ships with a covered hold, on account of the danger of explosion. It is only the heavy oils (and just the residue from the distillation of petroleum) which can be used safely on board of ships. But these oils are but a small fraction of the whole quantity of unrefined petroleum to be had in the market. Unrefined petroleum is itself dangerous on account of the light oils and the essences which it contains.

The petroleum beds may be very widely distributed on our planet and be nearly as inexhaustible as is coal ; but we know nothing surely just now, and, in any case, these beds have not yet been worked.

Hence the limitation, present at least, to the use of liquid fuel (petroleum residue) at sea. Coal is still king.

For this reason, Mr. Soliani thinks that the success of marine driving engines with direct combustion in the cylinders will be easier and more rapid for gas engines, which, in addition to the low cost of fuel, have, over liquid engines, the advantage of a somewhat greater efficiency, at least for the present.

In the matter of experiments on screws, and the reports of Messrs. Rota and Pecoraro, Mr. Soliani, after having confirmed the opinion expressed in his report, takes advantage of the opportunity to testify to the debt of gratitude which, in his opinion, is owing by the whole marine world to Mr. E.

Froude and to his father Dr Froude who, by their experiments on the models of hulls and screws,have contributed enormously to the progress of navigation. And the Italian Navy in particular owes a debt of gratitude toward the British Admiralty and to Mr. Froude for the wealth of information and advice with which they have assisted it in the erection and development of the Froude experimental tank at the Spezzia Navy Yard.

Colonel Rota, of the Naval Corps of Engineers. — Gentlemen, I regret much that I am unable to give the results of the experiments announced in my report. These experiments, authorized by the Minister of the Navy, were to have taken place at the Royal Navy Yard at Spezzia, and I proposed to show, outside of the theoretical conclusions already pointed out, that the utilization of a force on a motor shaft was greater in the case of propulsion with two coaxial screws turning in opposite directions, than it was in the case of a single screw. Unfortunately, these experiments could not take place up to now, but I hope to bring them about ere long.

In its principle, the system is not new ; it has long been used for automobile torpedoes and also in a few small boats ; the motion of the two screws is had, in all cases, by gears driven by the same motor. The use of rotary motors will allow the coaxial double-screw system to be applied even to ships.

The theoretical deductions summed up in my report allow the anticipation of success for the system so far as utilization is concerned, and it is possible even now to state clearly that the influence which the dimensions of propeller wheels and auxiliary parts fastened to the hull exert on the resistance to the speed of the boat must certainly be greater in the case of the coaxial double screw, either with the ordinary arrangement when the common axis is in the longitudinal median plane of the vessel, or with two axes set one on either side of the ship and each carrying two coupled screws.

I must, before ending, thank the General Reporter for the consideration which he has been so kind as to give to my paper and for the remarks which he has added about the advantages which might be had from the application of the proposed system in the military point of view.

The PRESIDENT. — After having thanked the speakers, he asked the Meeting what conclusions could be drawn from the statements just made in what concerns the consequences of the advances in the means of propelling ships, regarded from the point of view of channels and ports.

On the proposition of Mr. NYSSENS-HART, the Meeting adopted the following conclusion :

« In the present state of technical development, the progress » made in the methods of propelling ships has no influence on » the arrangements of channels and ports. »

The PRESIDENT begins the discussion of the first communication : « Rapid increase in the dimensions of sailing and steam » vessels ; their draught ; consequences for ports, channels and » approaches », by giving the floor to Professor JORINI, the General Reporter.

Mr. A. F. JORINI. — The subject of the rapid increase in the dimensions of ships and of the consequences resulting therefrom for the constructions belonging to ports and channels, has been treated already in important communications laid before the Congress of 1900 by Messrs CORTHELL and VÉTILLART. These authors present in their latest articles all the statistical data which they have gathered in relation to maritime navigation during the last five years. These data confirm the previsions which Mr. CORTHELL had expressed formerly as the result of a half-century's experience ; these previsions may be considered as having been more than fully realized. Mr. CORTHELL's feeling is that the type of vessel toward which the merchant marine of the world is tending, in its development, would be 1000 feet long, 100 feet wide, with a draught of 33 to 35 feet. Hence the works of improvement of first class ports and of the most important maritime canals should be adapted to vessels of this type so as to satisfy the nautical demands of such dimensions.

Mr. VÉTILLART, referring to the theoretical and experimental considerations given in his preceding paper, finds that, after the realization of the improvements due to mechanics and to

naval architecture,the advance in maritime transportation so far as economy, regularity and speed are concerned, has a necessary connection with increased tonnage, and that the most effective means to attain these ends is the use of deep draughts of water. He concludes that the ports open to over seas navigation should be able now to receive vessels 200 metres long, 20 m. wide and drawing 9 m., and that in the new installations these dimensions should be raised to 240,24 and 10 metres, respectively.

Mr. Verdinois' communication refers mainly to the Italian merchant marine, for which he finds that a type of 140 m. in length, 14 m. in width and 8.5 m. draught is ample. — The three articles laid before the present Congress, although they treat the development of ships very broadly, do not exhaust the matter. — In view of the importance of the subject and of its ever present actuality, for the limits within which harbor works should be kept in order to meet the necessities of navigation without incurring excessive expenses must be always borne in mind, it is proposed that it be retained on the programme of the next Navigation Congress.

Mr. Soliani. — Recalling the fourth conclusion of his General Report, he says that the question of the « Consequences of the advances in naval Construction as affecting channels and ports » can be reversed, because, the conditions under which ports and channels are established are just those which the limits of the advance of ships demand.

Large size for vessels is eminently advantageous, and any progress which may influence naval construction will be utilized rather to increase the size of ships than to lessen it. — If there were no limit to the extent and depth of ports, the dimensions of ships would be determined solely and naturally by the amount of traffic to be handled. — Hence the question is rather one of commercial economy than it is technical.

Now, the retarding influence of the present state of ports and channels is beginning to make itself felt. The depth of many ports is insufficient, and nearly all dry docks are neither wide nor deep enough for the free development of the dimensions of ships.

We may expect to see, in the near future, vessels afloat 300 metres long, 30 metres wide and drawing 12 metres light. These

are the smallest dimensions for which preparations should be made in the principal ports receiving the great lines of navigation.

Keeping pace with the development of the great dimensions of ships, preparations must be made to provide in all ports for prompt loading and discharge, without which the economic advantages to be obtained by large dimensions will not be realized.

Mr. SOLIANI ends his remarks by rendering hommage to the genius of Brunel who, when no one dreamed of it, created, out of weaker materials and much heavier and more bulky machines than those of to-day, a ship, the *Great Eastern* which is a marvel of conception, structure and size, even when compared with the modern steamers of which it was the pioneer, and which did not succed commercially solely because traffic then was not sufficiently great.

The PRESIDENT, after having thanked the two speakers for their interesting remarks, said that, in his opinion, no conclusion could be formulated on the subject of this communication. He agreed with the General Reporter that, in view of the importance of the matter and its ever presentness, it should remain on the programme for the next Congress. — Nevertheless he submitted it to the sense of the Meeting.

As no one rose to speak, the above expression of opinion was adopted.

The PRESIDENT gave the floor to Professor ANCONA, General Reporter for the second communication : « Use of liquid fuels in navigation. »

Professor ANCONA gives a résumé of his general report which bears on two points, viz :

1° On the use of liquid fuel in marine boilers ;

2° On the use of liquid fuel in motor cylinders.

On the first point Professor ANCONA lays down the following conclusions :

Agreeing completely with Admiral Melville's statements, I say with him that the problem of the use of petroleums in marine

boilers has been solved perfectly from the technical point of view. It was solved on the day when was made the first atomizer capable of giving a forced combustion; that is the modern steam, compressed air or mechanical atomizers.

Liquid fuel is, undoubtedly, more perfect, more convenient, it might almost be said more *advanced* than the solid. When it is remembered that complete combustion — which is the ideal — requires that every atom of carbon and every two atoms of hydrogen shall be in direct contact with an atom of oxygen, it will be understood that such a state of things can be the more closely approached as the fuel is the more comminuted, and consequently that the liquid state, by reason of its great facility for passing to the gaseous, lends itself much more easily to contact than does the solid, and, consequently, to complete, economic and smokeless combustion, smoke being ever a sure sign of incomplete combustion.

The following advantages, to mention only the main ones, must be added :

1° Greater concentration of calories, and consequently less weight and greater radius of action ;

2° Greater boiler efficiency through more perfect combustion ;

3° Greater facility in firing, and a reduction of at least 50 % in boiler room force, with greater ease in regulating the fires, in keeping them in perfect order, with the absence of smoke and ashes ;

4° Greater facility of loading, storage and supply ;

5° Better preservation of the boilers and absence of all trouble from grates.

And it will be easily understood that their use is truly to be desired.

Unfortunately, this use is hampered in its development by a series of difficulties. First, the world is not organized for using liquid fuels, then the quantities of these fuels to be had are still much too expensive by reason of the cost of transportation, and all for lack of a good organization.

As in the case of coal, the large petroleum stores can only be by the sea, and must be served by petroleum boats. Now, the construction on broad lines of large petroleum vessels, furnished with the necessary ontfit for taking in and discharging cargo promptly, has only just been begun.

I mention with pleasure one of the largest in the world, the *Narragansett*, built last year by Messrs. Scott and C° of Greenock (Clyde) for the Anglo-American Oil Co. The *Narrangansett* is 162 metres long, 19 metres wide and 12 metres deep, and carries a load of 12.500 tons, of which 11.000 tons are petroleum ; when fully loaded, the vessel displaces 21.000 tons. It is divided into twenty-seven tight compartments, from which, because of a special caulking of the plates,even petroleum cannot leak. The engines, of 5.500 H.P., are amidships ; the shaft alley is ventilated by means of three wells. There are eight bulkheads forward of the engine space and the same number aft. There are, for discharging, two SNOW pumps which will pump out the 11.000 tons in twelve hours. The *Narragansett* can be easily transformed into a troop ship, or into a vessel for general freight.

With such tank ships, petroleum can be furnished economically at stations scattered along the great lines of navigation at less cost than under present conditions.

It is well understood that the natural insurmountable difficulty which prevents wide diffusion lies in this, that petroleum exits in nature only in very small quantities. The total production is only 12 % of that of coal, and the liquid fuel is but about 4 % of the solid. Hence, for the time being, it is very small. But it is probable that, either by the discovery of new sources of supply, or a better utilization of these already existing, the world's production will increase rapidly. Good tokens are not lacking, and it is earnestly to be hoped that the great advantages of liquid fuel, especially for light vessels, may be more fully utilized in the future than they have been up to now.

This is undoubtedly what will happen.

On the second point, Professor ANCONA presents the following conclusions :

The problem of reversing the motion of internal combustion motors has not yet been solved. But if it be not so today, it may be to-morrow, and it must not be forgotten that difficulties of construction are the easiest to solve and that they will be confronted successfully with our perfected means and methods is almost certain. The most beautiful proof of this is furnished by explosive motors for automobiles. Their dynamic qualities made them much less suitable than are steam

motors ; still, in order to enjoy the special advantages of liquid fuels, ingenuity has found the means of overcoming difficulties of construction in a way at least sufficiently sure for practice, if not always happily and elegantly.

The economic superiority and the lightness of these motors, as compared with those driven by steam, result from the very nature of the phenomena which take place and are, consequently, immutable, save in this that, while the internal combustion motor still leaves some field for improvement, even from the thermic point of view, the steam motor has reached a limit of perfection which leaves no margin.

The liquid fuel motor, and especially the one for petroleum, will have, I am convinced, a great future in navigation. Constructors have understood this. Beside the well known English houses who have taken the matter up, a few Italian houses, such as the *Bacini* Society, the *Fiat* automobile factory at Turin, and other important houses are working upon the construction of petroleum motors for navigation.

Unfortunately, in Italy, petroleum and benzine are subject to a customs duty of 48 *lire* per 100 kg., a duty as enormous as it is absurd, the fruit of the absolute ignorance of our legislators as to the advantage which cheap petroleum would give to the national economy, an advantage infinitely greater than the deficit in the budget caused by the reduction of customs receipts.

One fact worthy of notice is that, in the domain of automobilism, be it on land or on water, electricity which has triumphed so often elsewhere, remains here in the secondary rank and may perhaps remain there always. Here too is encountered a difficulty of principle : electric machines are, by their very nature, too heavy, and the light electric accumulator seems an impossibility. On the other hand, the transformation of the caloric of petroleum into work is more automatic, more simple, more economical than no matter what transformation whose intermediary is the electric current. Electricity lends itself admirably to being broken up into parts, to yielding, to being subdivided into small quantities, but it requires a single, complex and consequently immense central station which, producing it in large quantities, distributes and subdivides it into very small quantities. But the production of electricity on a small scale is not advantageous, while, on the other hand, the

Naples. — Castle of St-Elme

great merit of internal combustion motors is that they can produce force on a small scale.

The true and proper field of action of the liquid fuel naval motor is limited, for the time being, to powers not exceeding 500 H. P. or thereabouts ; that is to say : it is reduced to what may be called, for navigation, the *circle of small forces*. The *Diesel* petroleum motor is the largest so far built ; it is now on exhibition at Liège ; it has three vertical twin cylinders, and gives 500 H. P. at 150 revolutions.

What the future has in store cannot be foreseen ; still, it does not seem probable that this domain can be extended to any great degree, for neither gas motors in general nor petroleum motors in particular seem suited to powers of thousands and thousands of H. P., which are so common in navigation and in which the steam motor maintains intact its wonderful qualities of action, regimen and safety.

So far, the type best suited to navigation is the *Diesel* — an essentially petroleum motor, which, be it well noticed, can work with no matter what other liquid fuel, but with less economy however. — Within the limits of power mentioned, the application of this motor may be very great and be extended to vessels for river navigation, and especially to those of light draught ; be they launches, tow-boats, submarine boats of all sorts, fishing, pilot, life-saving boats, etc., etc.

And, further, the substitution is of great economic importance, because it is the well understood economy of the petroleum motor which is going to replace the waste — a real waste ! — of the steam motor of small power.

The difficulty of reversing and its small elasticity are, as has been seen, two disadvantages inherent to the internal combustion motor which make it necessary to resort to expedients which are not to be recommended and are not altogether safe. But what importance can these transitory disadvantages have in the face of this steady, enormous, inappreciable advantage of doing away with boilers, condensers, coal and firemen, the four plagues of steam navigation ? And also, in the face of this other but not less important and certain advantage of substituting for the kilogramme or kilogramme-and-a-half of the steam motor, the 250 to 300 grammes of the *Diesel* petroleum motor. Add to this the advantages arising from increase of lightness and enlargement of the radius of action.

Every one is convinced that under such conditions and with such advantageous perspectives, the attention of constructors must turn toward petroleum motors for navigation ; surely a brilliant future is reserved for them.

Let them start out then on this line with breadth of view and mature preparation, without ever forgetting that if this motor be thermically an advance over the steam motor, it is, in the matter of construction, more difficult and more delicate.

The patience of the old WATT motor is no longer of our time. The petroleum motor, born and grown up with us,, does not know it nor can it abide it : and this it is which must not be forgotten.

Mr. ANCONA adds also that he does not agree with the opinion expressed by Mr. SOLIANI in connection with the second question, viz., that the thermic efficiency of gas motors is greater than that of petroleum motors ; on the contrary. He gives the heat efficiency of different kinds of motors :

For petroleum motors, from 17 to 33 % ;
» gas » 23 % ;
» steam engines 12 %.

He believes also that the following distinction will be made in the general application of motors to vessels :

Steam engines for very great powers ;
Petroleum motors for medium and small powers.

He concludes by remarking that, up to now, the experiments made with the different new motors have not been sufficiently followed up. He would be glad if the decision of the Congress were favorable to the encouragement of new tests in accordance with its own conclusions.

Mr. SOLIANI. — I agree with Mr. Ancona in so far that experiments with petroleum motors should be favored. The sport which has made such a bound forward in nearly all countries, has been a wonderful aid to us and will aid us still more in the future to make new and rapid advances in these motors ; at the same time, scientific experiments will always be very useful. But I am not yet wholly convinced of the importance of petroleum for navigation. In speaking of petroleum as a fuel, it is necessary first of all to make everything clear, because there are

included at times under the name of petroleum : crude petroleum, essences of petroleum, and other products of the distillation of crude petroleum as well as the residues of distillation : all these materials are very different from each other.

Petroleum essences and even paraffine or kerosene obtained after the essences in the partial distillation of crude petroleum, cannot be used in navigation at sea on account of dangers of explosion, real dangers which make the public distrustful of harmless petroleum residues. I must recall here the case mentioned by Messrs Narten and Techel, in their report of a steamboat on board of which the passengers refused to take passage so soon as they learned that petroleum was used as fuel : and it was only petroleum refuse.

It is true that essences of petroleum are used in small boats where there is no danger of explosion, the hull being open. But if it were a true ship with a deck, the danger would be very serious. It is true, too, that essences are used on submarine boats, but they are tolerated for lack of something better, while waiting for motors which are just as light and compact and which use heavier fuel.

The *Diesel* motors have solved the problem of the use of heavy oils, their action being perfect even with the heaviest ; but these motors are too heavy and bulky for application either to small boats or to submarines.

So far as weight is concerned, petroleum may be considered the ideal fuel for ships, but there is not enough of this fuel on the market. Coal is found at every port, along every line of traffic, so that navigation is perfectly assured ; but petroleum is not so found. The products of petroleum are all absorbed at present by other industries, and if there be, perhaps, within the earth enormous deposits capable of supplying all the needs of industry and navigation, it is none the less true, in my opinion, that these deposits and this production are as yet merely potential.

Mr. Von Sandick. — Mr. Soliani has expressed the fear that the quantity of petroleum to be had at present might become wholly insufficient in case that its general use for steam engines were required. I think that Mr. Soliani's fear is not well founded. Although petroleum deposits are found everywhere,

the production of petroleum is very much limited at present by reason of the trusts which control it almost absolutely, and whose interest it is not to produce it in excess so that the price may not fall. But if crude or refined petroleum, heavy oil or light, were called for in large quantities for ships, the consumption would increase, the market price would rise and the trusts naturally would enlarge their output.

Although this Congress is not a petroleum but a navigation Congress, I insist on replying to Mr. Soliani by stating that there can be had, in any case, as much petroleum as may be called for. Newly discovered beds give a nearly unlimited output; very rich deposits have been found in California; and I have seen petroleum wells even in the Great Ocean. The Dutch East Indian colonies, especially the islands of Java and Sumatra, are very rich in petroleum.

Hence I conclude that the fear of a lack of petroleum being the determinant cause of the impossibility of using this fuel generally for marine engines is not well founded, at least for the near future.

Mr. Salvatore Orlando, Engineer. — I did not intend to speak at this Congress where I came just to hear the communications of other members; but as Mr. Ancona mentioned in his general report certain experiments in petroleum combustion, made under my direction, on a vessel of the Navigazione Generale, I shall be glad to say a few words. On this occasion, comparisons could be made between petroleum and Cardiff coal combustion on two twin boats, the Thebes and the Cairo, having equal engines; they were tried at the same immersion of hull, at the same degree of general expansion of 4/10, and at the same initial pressure of 12.66 atmospheres, and obtained the same development of power.

The petroleum burned on the Thebes was a heavy mineral oil from Texas, which — as is well known — contains only about 23 % of pure petroleum and small amounts of benzine.

This liquid, which is thick and very sticky, may be contained easily in ordinary receptacles on board, mainly in the double bottom where it really was placed; having none of the qualities of fluidity of the refined petroleums, which require especially tight rivetting, it causes no leaks through the bulkheads. Hence

it is a question of a liquid which can be carried by all boats, provided that they have a double bottom.

The flashing point of this liquid was about 91°, while the full ignition point was 110° ; if anything alight were thrown into the cold liquid the latter did not take fire. It did not develope much gas at normal temperatures, so that on board only a few vents on the deck sufficed to carry it off and remove all danger from the transportation of this petroleum in the double hull of the boat.

Combustion was obtained by two Koerting direct sprinkling atomizers, the temperature of the liquid being first raised to 90° by steam coils, and a pressure of three atmospheres being given by Blake pumps.

The following results were obtained :

(I speak from memory, because, as I said, I was not prepared for this discussion). We burned 0.45 of petroleum per I. H. P. and per hour, whereas on the twin boat the consumption of Cardiff coal rose to 0.68 per I. H. P. per hour, including in this figure the losses due to the changing of furnaces. Hence there was a great economy increased by the reduction of the number of firemen (about one-half), by smaller cost of loading the fuel, sweeping and unloading ashes in port.

Nevertheless all these savings were annulled by the fact that the crude petroleum of the single depot at Alexandria sold at 35 shillings a ton, whereas the Cardiff coal at the same port cost only 22 shillings. This high price of the Texas petroleum which cost, at the point of production, but about 6 shillings a ton, was the effect of the action of the petroleum trust ; this increased cost of fuel counterbalanced what economy was obtained in combustion, so that the net cost of coal and fuel firing was about the same.

This is the reason which, added to the lack of a petroleum depot in Italy, prevented the experiment — which had been very successful — from being repeated on other boats of the same company.

The action of the trusts has sometimes results when they aim at exploiting an inland market, but they accomplish almost nothing when they act in an international field.

I add that I do not agree with Mr. Soliani, and that I have every confidence in the practicability and safety of the combustion of crude petroleum and of petroleum residues. I even hope

and I wish that, once the action of the Trusts being held in check, the use of petroleum as a fuel may develope to the extent which it deserves.

Mr. Ancona. — In the matter of the dangers pointed out by Mr. Soliani, relating to the application of petroleum to ships, he says : that there are dangers in every kind of industrial appliance and that these dangers generally increase as the application becomes more ingenious. It is only necessary to take the precautions required to avoid accidents. There are already on the Black Sea large vessels which run with petroleum motors, and no trouble is mentioned.

As to the motors themselves, Mr. Ancona does not agree with Mr. Soliani, and he devells on the opinion that the *Diesel* motor has a great future in navigation, at least for powers not exceeding a certain limit, set to-day at 500 H.P. There is, of course, the very grave defect that reversing has not yet been obtained ; the solutions proposed, electrical reversing for example, are not really practicable.

As to Mr. Soliani's objection in relation to insufficiency of the stock of petroleum for the needs of navigation, reference is made to what has been said by preceding speakers.

Mr. de Thierry. — I have taken the greatest interest in the discussion of petroleum motors and their application to navigation as I have listened to what has gone on in this hall. There are at present two houses engaged in the construction of these motors : the *Diesel* factory and the establishment of *Carels Brothers* ; both use for these motors heavy oils, that is crude petroleums. I have seen several of these motors at work and I must say that the system is not yet free from defects : the greatest of these is the inability to reverse. But they are working hard to correct this difficulty. As to the insufficiency of the petroleum supply for navigation, I do not think that it is worth while to worry about that, although the petroleum beds are not, to tell the truth, as abundant as the coal formations.

Mr. Roundo. — So far as the attempts to obtain reversing in petroleum motors are concerned, I find the system of the *Diesel* motor (electric transformation by means of dynamos) quite worthy of recommandation.

The *Nobel* establishment has also found an arrangement looking toward the same end, and I hope that Italian houses will follow up these attempts with success.

The PRESIDENT. — As the discussion of this communication has gone far enough, the Meeting is requested to draw up a conclusion.

Mr. ANCONA proposes the following conclusion which is unanimously adopted.

« Petroleum motors for navigation can and should be applied » more widely for powers up to 500 H.P. »

The meeting adjourned at 11.30 a. m.

II[d] SECTION

(Maritime Navigation)

III[d] SESSION

Wednesday, September 27, 1905

President :

Commander Ignazio Inglese, Inspector General of the Corps of Civil Engineering.

The meeting was called to order at 2.45 P. M.

The President submits for discussion the IIId question : « Statement of the various ways of operating and administering » Seaports ; their influence on the development of trade », and gives the floor to the General Reporter.

The General Reporter, Mr. Mazza reads, in French, the following conclusions :

1° The best form of administration for a port seems to be that of a governmental office, because the State cannot hold aloof from being one of the greatest economic factors of the general well-being of the country, and because the State alone can provide for works which are not at once and immediately required.

2° In order to obviate all trouble from the delays which are inseparable from a governmental administration, the State must be represented in the operation of the port by a single person who is directly responsible for the whole administration and to whom all services of every kind are subordinated.

3° The heads of the various services should be directly under the control of the director of the port, so that a single impulse may be given along a single line of direction.

4° Nothing interferes with the director of the port being assisted by a Council of which the chiefs of the services of the port, ship owners, ship captains, representatives of commerce and industry may be members.

5° The works of the port should be carried on along a preëstablished organic plan, in which the works to be done are specified in the order of urgency as determined by commercial needs and the available funds.

6° It is desirable that the plant of the port (derricks, sheds, storehouses, docks, &c.) should be built and managed by Companies or private parties, in accordance with tariffs previously inscribed in the contract of concession.

Mr. Gullini proposes to collect into one the first three conclusions of the General Reporter, suppressing the idea that the administrative office of the port should be governmental. He proposes the following form :

1° The best form of administration for a port seems to be that of an office in which are concentrated all the functions of the Port.

The head of the office will be directly responsible for the whole administration, and the heads of the different services should be directly under him, so that but a single impulse and a single direction may be given to these services.

The President observes that the Government cannot stand aside and not be in touch with the economic factors for the well being of the country such as are the ports.

Mr. Gullini answers that the Government will always be represented by its functionaries who must be necessarily a part of the Council of Administration of the port.

Mr. Nyssens-Hart. — I take the liberty of making some objections to the conclusions which propose clearly that the administration of the ports be turned over to the State ; and I think that these conclusions will find more than one opponent.

The account of the organization of the ports in every country may give useful information, but then again different organizations may perfectly well give excellent results. The principle which, in my opinion, should control in the organization of ports is the following : Place the directing and deciding authority as close as possible to those who use the port, so that the necessities which appear may be examined and weighed at once and that adequate relief measures may not drag. Reduce administrative gearings to a minimum ; yield quickly to the ever changing demands of commerce and navigation, such should be the end to be pursued in the etablishment of the service of the port.

But every country has its traditions : In Belgium the ports are administered by the towns ; the State bears the cost of the means of access to the ports and docks ; the management proper is the affair of the corporation.

A few years ago, however, this principle was set aside : When the legislative Chambers decided upon the ports of Zeebrugge and Bruges, the principle of operating by the city of Bruges was changed. Undoubtedly, this administration, unaccustomed for centuries to the management of ports, felt a certain hesitation in taking charge of the handling of these new constructions whose cost will reach 55 millions of francs (=$ 10,600,000=£ 2,200,000). So the State granted the operating of these ports to a private company. This latter has a broad autonomy, and the new works which it undertakes must be repaid to it by the State or by the City when the concession expires.

It is evidently premature to give results of this system, but it approximates the English system and respects the essential principle laid down at the beginning of my observations. In my opinion it is the best of all because it suppresses the most wheels, makes it to the interest of the management to satisfy trade, and does away with all influences foreign to the direct object of operating the port.

Then comes operating by the City, which keeps in its turn a certain suppleness, and, I do not hesitate to place it quite at the end, operating by the State, where the complication of machinery cannot be proportional with the demands of good management.

Mr. Joly. — If the advantages and disadvantages of the different systems of administration of ports be examined, one is led to think that administrations given into the hands of private Societies of short duration (15 to 30 years) are well placed for operating, as it is to the greatest interest of these societies to obtain in this short time the largest profits from their operations, which can only be had by developing traffic to the highest degree and by giving the best possible service to clients, in order that they shall not go elsewhere. Whereas in England, there are compagnies whose life is unlimited, the societies for operating ports in France, of which for that matter there are but two, have a quite short period of duration, and require, in consequence, to realize very large profits at once.

Mr. Joly thinks that it will be extremely hard to find a special form of administration which can be applied to all countries.

Mr. Vernon-Harcourt. — The system of operating ports applied in England differs greatly from that in use on the Continent. There are in England, in a few cases, Commissions which try to reconcile the interests of the port with those of trade ; but as a general rule every port does its best to satisfy the needs of traffic and of navigation. In this a powerful aid arises in the form of competition. Thus the port of Liverpool, whose natural conditions were unfavorable, had to sacrifice enormous sums of money and had to bring about very extensive works of improvement and construct an immense plant, in order to compete with Southampton to which access was naturally easy, where there is plenty of depth and where the quays were well sheltered ; all of which brought to Southampton several important lines of navigation.

He concludes that, no matter what the port may be, an essential condition for life lies in following up every improvement which may facilitate trade.

Mr. von Doemming. — A clear distinction between the conditions of different countries must be made in this question. In Germany, not only must the different governmental and communal administrations be defined, but attention must also be paid to questions of *possession* or property. For example : the ports of Emden and Geestemünde belong to and are managed by the State : the second is well developed by reason of

its fisheries. But there are also very important communal ports which have reached a high degree of development, *e. g.*, Stettin, Königsberg and others. These ports could never be managed by the State.

Furthermore, State management possesses the special disadvantage of not being able to respond quickly enough to the ever changing needs of traffic, which arise sometimes unexpectedly. In the opinion of the speaker, special consideration should be given, in the conclusions, to the necessity of concentrating the direction of the different branches of the service of the port in one Central Authority provided with all the powers required for the harmonious Administration of common interests.

Mr. Royers. — We have had a debate on a question which raises many others and which, surely, cannot be completely elucidated. Every form of administration has advantages and disadvantages, and a formula which suits seaports will not be applicable, in a general way, to railways, mines, &c. Each problem offers difficulties which are too especially its own.

In certain respects, the State is in a very good position for developing ports in the most suitable way. Dimensions of ships are increasing and require sometimes enormous works which must be built beforehand and without expectation of any immediate corresponding receipts. Protection of the general interest lies in the State, a necessary agent in the administration of a port.

The resources of the State are unlimited, in a way : and this is an important factor in solving large problems ; on the other hand, an administration by the State has the very great disadvantage of being too far away to keep in touch with the desires of the clientele of the port. It requires an immense amount of time to reach a decision.

A Belgian minister said : if government is good from afar, administration is good only when near at hand. The formula of a concessionary society may be interesting. This society seeks clients. It is, so to speak, a travelling salesman, but the general welfare does not enter its scheme. It must find funds to keep itself up to the mark, and as its life is limited, its cares will not extend beyond the limit of its existence. It will not anticipate progress and, more than this, its credit will be

limited. In England, the societies which operate ports are of another kind ; they can provide for long terms because their concessions run for 999 years, that is for a practically unlimited time. These societies however always tend toward an intensive form of operating, they reach out for the most productive traffic, and neglect sometimes one which is necessary but less lucrative. — So, after all said and done, it must be admitted that there are advantages and disadvantages in everything.

Mr. Nyssens-Hart. — Mr. Royers has not shared the opinion I expressed in the matter of the operating of ports by the system of Concessionnary Companies. However, we really agree on the principle which consists in making very easy the administration of ports. He does not favor the concessionary company except in the English form of unlimited concession. We have before us, however, in our central and northern countries, evident proofs of the activity, the need of advance, the care for the future and the credit of concessionary societies. Are improvements in machines, signals, stock owing to the State? Is it not the private companies which are always abreast of all improvement? And these last penetrate very slowly into the operations of the State.

The role of the travelling salesman has become that of an important, essential, primary aid to commerce and to business transactions. The Belgian State also has its commercial agents in foreign parts, like all important navigation lines and railway systems.

If, as in the concession for the port of Bruges and Zeebrugge, the State and the City are under the obligation to purchase all the installations made by the Company in order to carry on its operations, the financial care disappears, a sinking fund becomes useless, credit is not limited by the life of the concession, and prospectives of the future lie wide open.

So Mr. Nyssens-Hart preserves all his preferences for an autonomous system of operating.

Mr. Fries. — I agree fully with Mr. Nyssens-Hart as to the advantages offered by the handling of ports by concessionary companies. Even in Italy, where ports were administered by the State until 1902, the need was felt of intrusting the manage-

ment of the port of Genoa, the most important of the country, to a Consortium of the different interests. Strictly speaking, this is not a company ; still the administration of the Consortium is autonomous ; and as the number of members representing local interests is less than the number of functionary members (selected by the Governement), the general interests are sufficiently protected.

Experience will show the good and bad points of this system whose adoption is still too recent for the formation of any judgment.

Mr. Mazza, General Reporter. — After the preceding discussion, I propose to change the first of my conclusions as follows: The choice of the best system of administration for ports in accordance with local conditions, should be left to the State, whenever such choice is possible.

Mr. Inglese, President. — The question submitted to the Congress is not to find out what is the best system of administration for ports ; it is only asked what may be the influence of systems of administration on the development of traffic. He appreciates the remarks made by Mr. Nyssens-Hart and other speakers as to administration by the State, which would act too slowly in the decisions and steps to be taken to satisfy the needs of traffic and in following up the interests of the port ; but he thinks that it is merely a question of simplifying the machinery. If this simplification were realized and if the State applied to the development of traffic all the means which the continual progress in the management of works and in equipment can suggest, its administration might very well not be inferior to that of private societies. He thinks however that any administration, even that of the State, may be good, under condition that it provide very quickly and as far as may be necessary for the needs of traffic, taking into consideration not only the port proper but all the installations which belong thereto, especially the railway systems. The action of the State is most appropriate in what concerns these last.

Mr. Mengin-Lecreulx is also of opinion that to each country should be left the choice of the most suitable system for the

administration of its ports, and furthermore that no exact conclusions can be reached in the qestion of knowing what is the best system for the development of traffic. Although he is, in his own country, a functionary of the State, he thinks that the administration of a port by a private company offers more advantages, as the company is more free to struggle as it deems best against competition.

After other remarks, the following conclusion proposed by Mr. Joly is adopted :

« Any system of administration which favors the prosperity » of the port and the development of traffic is good, provided » that the administration be itself good. »

The President then starts the discussion on the communication : « Responsibility of ship owners toward private parties » and public administrations », by giving the floor to the General Reporter, Professeur Berlingieri.

Professor Berlingieri. — The question of the responsibility of ship owners toward private parties and public administrations is one of the most delicate from the standpoint of the legislation of different countries.

It is needless to say that when the responsibility of ship owners is spoken of, the responsibility for acts of the captain and members of the crew is meant. So, three different systems may be pointed out.

A first system is that of abandonment, adopted by the French and all other legislations of the continent save the German, Danish, Swedish and Norwegian.

By virtue of this system, the owner is personally responsible, in principle, for the acts of the captain and the crew in whatever relates to the ship and the voyage. But he can free himself from this responsibility by abandoning the ship and cargo.

Another system, somewhat like the preceding, is that of the German Code and of the Scandinavian legislations. The owner is not held personally, but his responsibility is limited, by law, to the value of the ship and cargo, which are the sole guarantee for the creditors of the ship.

There is still a third system : the English. Under this system the owner is personally responsible for the acts of the captain and crew. But, whereas in the other legislations the obligations of the captain for the needs of the ship may be satisfied through abandonnent, the English system, on the contrary, does not admit that the owner can limit, in any way, his responsibility for the obligations contracted by the captain. Still, according to the English legislation, the responsibility of the owner is restricted in certain cases. These are cases of fire on board, thefts of precious objects, where exoneration is complete if the damage has happened without a personal fault of the owner. In other cases the responsibility is limited to a maximum of £ 15 per ton if it be a question of loss of life or personal injuries, and of £ 8 per ton in case of damage or loss to goods or other things on board the ship.

As you see, Gentlemen, these three systems may be reduced to two : the English and the Continental. The first admits, in principle, the personal and unlimited responsibility of the ship owner ; the second limits responsibility to the value of the ship and cargo.

In the presence of these utterly different systems, some means for avoiding conflict of legislation has become absolutely necessary, and for more than seventeen years these Congresses have tried to do away with it.

Leaving aside the Congresses of Antwerp (1885) and of Brussels (1888) where resolutions were adopted to render the continental system general, it was the meetings held under the initiative of the International Committee of Maritime Law, founded at Brussels, which began to pursue the end of acting on the governments of various countries in order to reach uniformity in questions of maritime law. It was decided at the meeting held in London in 1899 to allow ship owners to choose to free themselves from all responsibility, either by abandoning the ship and cargo, or by the payment of a sum of money calculated in accordance with the tonnage of the ship.

The question was again discussed at the Hamburg and Amsterdam meetings. A commission was appointed at Hamburg (1892) to draw up a preliminary project. As the Continental delegates to the Liverpool Meeting of 1905 had abandoned their idea of limiting the responsibility of the ship owner for obligations contracted by the captain during the voyage,

Naples. — The Port.

it was finally decided to allow the owner to choose between the English and the Continental systems in the following cases : —

1. Damages caused to third parties by errors of navigation ;
2. Damages caused to the cargo carried ;
3. Damages caused to breakwaters and other permanent objects, including the cost of removing the vessel.

Such, Gentlemen, is the history of the subject.

Two note-worthy reports on this question have been presented to the Congress, one by Mr. Verneaux, Chief of the Claims Office of the Messageries Maritimes, and the other by Mr. Charguéraud, Chief Engineer of the Ponts et Chaussées.

Mr. Verneaux, after having given a review of the various systems governing the responsibility of ship owners, proposes the conclusion prepared by the French Association of Maritime Law as a means of reaching an understanding between the different nations. This text, which is in conformity with what the Maritime Committee considers desirable, is conceived in the following terms :

« Article first. — The owner of the ship is not bound personally, but only by the ship and its accessories for the trip :

» I. For the acts of the captain, of the crew or of any peron assisting the captain in the service of the ship ;

» II. For the fulfilment of contracts coming within the legal attributions of the captain and made either by him, or in his name by any other person, even by the owner of the vessel ;

» III. For the condition of the ship, in the matter of hidden defects, if all due diligence has been observed to have the ship, from all points of view, in good navigable condition.

» Article second. — The accessories of the ship, for the application of the preceding article, include :

» I. The gross amount of the freight or passage money, although paid in advance, less the cost of special revictualing required on the trip ;

» II. The sums due or paid as contributions for common damages, for assistance or salvage, or for repairs of damages of any kind ;

» The premiums due or paid by reason of insurance contracts on the ship are not considered as an accessory of the ship.

» Article third. — The owner of the ship may substitute for » the ship its value at the end of the trip or the price at which » it was bid in at forced sale before the end of the trip.

» Article fourth. — The owner has the privilege in all cases » of freeing the ship and its accessories by the payment of an » indemnity which shall not exceed, for any one trip, £ 8 per » ton gross tonnage of his vessel.

» Article fifth. — The preceding clauses apply to damages to » property of any kind whatever.

» They are applicable to the responsibilities relative to the » obligation of removing the wreck of the vessel in case of its » running aground.

» They are not applicable to the payment of the wages of the » captain and crew, which is considered as a personal obliga- » tion of the owner. »

Mr. Charguéraud limits his study to the question of the responsibility of the vessel and cargo toward the State and public Administrations. After having shown the origin of Art. 216 of the French Commercial Code, in its present form, he examines the responsibility of the owner to the State for injury done to harbor works, as well as for shipwrecks or going aground in ports, roadsteads and navigable channels.

The owner may, in either case (he remarks), take advantage of the clauses of Art. 216 Comm. Code, amended by the law of August 12, 1885, by abandoning the ship and cargo.

The two reporters finally express the wish that, through an international understanding in the interests of maritime navigation, the divergences now existing between the legislations of the different countries may be made to disappear.

Mr. Verneaux's report was presented before the Liverpool meeting, whose resolutions I mentioned a moment ago.

Consequently, I think that our Congress would carry out the ideas of our reporters and would testify warmly to its sympathy with the work undertaken by the International Maritime Committee, if it adopted the conclusions of the Liverpool Congress, of which Mr. Verneaux was a member, and at which nearly all maritime nations were represented.

Hence I propose the following conclusions :

« The Congress expresses the hope that maritime countries » may reach as soon as possible an international understanding

» as to regulating the responsibility of ship owners, by adopting » the system of transactions of the Liverpool meeting of » June 1905, according to which owners may elect, in all cases, » to limit their responsibilities either by the English system of » £ 8 per ton, or by the continental system of abandonment :

» 1. For damages caused to third parties by errors of navi- » gation ;

» 2. For damages caused to the cargo carried ;

» 3. For damages caused to breakwaters and other perma- » nent objects, including the cost of removing the vessel. »

Mr. Fries. — I should like to ask whether it would not be better not to enter into the details of the *desiderata* set forth at the Liverpool meeting ; this is why I propose to strike out the last part of the motion presented by the General Reporter.

Mr. Berlingieri. — Besides the most important English maritime bodies, eleven associations of the principal maritime nations were represented at the Liverpool meeting. Concessions were made both by the people from the Continent and by the representatives of Great-Britain with a view to reconciling the systems of the different legislations and to reaching a definitive agreement.

If the information now before the Congress on this question be not sufficient, the discussion can go over to another Congress ; but it is useless to pass a resolution merely for uniformity of maritime law.

Mr. Rösing. — I consider it as well understood that we should not enter into details. The question is one of very great difficulty, but it is studied thoroughly and with the greatest care by the International Mariitme Committee, and, in a few weeks, a meeting of the delegates from the maritime States will take place at Brussels and resolutions will be passed on the first preliminary project of the Maritime Committee. It is too late, therefore, for isolated deliberations. We should not go further than sustain the International Committee, so far as possible, in its labors. I do not think it necessary to strike out anything from Mr. Berlingeri's resolution which I approve fully.

M. Grenier. — Gentlemen, I think that the question has not been sufficiently examined, and that, from the general point of view, it would be better to see what measures should be taken in the different countries. To-day our information is lacking. We should see what are the captain's own responsibilities when he is the cause of injury to third parties.

The General Reporter. — Gentlemen, I think that the Congress should look at the question from the point of view at which it has been submitted to the Congress.

I was called upon to draw up conclusions on the two reports submitted to the Congress, and my communication lies within the limits assigned. You say that we are a Congress of engineers ; this I do not deny ; but you should refer to the question laid down in the order of business, a question which is wholly judicial. If the Permanent Board in Brussels has inscribed this in the order of business of the Congress, it has done so from the judicial point of view. You have only to read the title to be convinced of this.

The President. — I think that the Meeting should consider and determine whether the Congress is called upon to examine the question only as regards harbor works, roadsteads and navigable passes, or to make it general as the General Reporter thinks should be done.

Mr. Charguéraud. — Undoubtedly the question is wholly judicial, as the General Reporter says ; only it may interest engineers in so far as it touches the administration of ports ; we should look at it from this point of view. It matters little to us whether the owner choose between the English and the continental systems ; but it does matter greatly that single, well determined rules be laid down in the question of the responsibility of owners of vessels toward the public Authorities and toward the State in the ports.

Whereas in Italy and in other countries the question remains in the old condition of difficulty, in France the ship owner may take advantage of the clauses of the Commercial Code, which regulate the relations of the owner toward private parties by the abandonment of the ship and cargo, even to the State, and

the risks of this owner are limited, both before the judiciary and administratives courts, to his sea property.

I think that all that appears in Commercial Codes as regulating the relations between owners and private parties should hold in the relations between owners and public administrations, as is the case in France. But it seems to me that it is not for the Congress to draw up conclusions. I believe that the Meeting might resolve that the general question be referred to an International Congress of Maritime Law, not forgetting to regulate the relations between ship owners and the public Administrations by international agreements and rules, so that uniformity may be established in all countries.

The General Reporter. — The question cannot be confined to the one point examined by Mr. Charguéraud, but it should include everything which concerns the responsibility of ship owners. In France the system of abandonment has been adopted even for the responsability of ship owners toward the State : « In case of shipwreck » (see the amendment added by the law of August 12, 1885, to article 216 of the Commercial Code) « of the vessel in a maritime port, or in » the waters giving access thereto, as also in case of damage » caused by the vessel to the works of a port, the owner of the » vessel may clear himself, even toward the State, of all costs » for removal or repairs as well as from all costs for damages, » by abandoning the ship and all the cargo of merchandise on » board. »

The President. — I agree with Mr. Charguéraud, inasmuch as we know nothing about was done at the Liverpool Congress.

Prof. Berlingieri, General Reporter. — It remains then to be determined whether it be better to lay the question over to a future Congress or to draw up a resolution in the way indicated by Mr. Charguéraud.

Mr. Arenal. — I am against laying the question over to a future Congress. Engineers and public authorities are vitally interested in the establishing of uniform legislation to regulate the responsibility of owners toward public authorities and

toward private parties, and this legislation should be, in its character, not only general but international. I think that the Meeting should accept the conclusions of the Liverpool Congress. It has been necessary in all nations to limit the responsibilities of owners toward public administrations. Thus, in France, the system of abandonment has been introduced into the legislation ; and in Germany the owner has the choice between proceeding to save vessel and abandoning it, in case that shipwreck or injury should prevent or make more difficult the navigation of a channel or the entrance to a port. Complete uniformity would be very desirable in the legislations of the different countries in the matter of the responsibilities of ship owners in the case of damages caused both to private property and to harbor works. *(Loud applause.)*

Mr. VERSPREEUWEN. — My opinion also is that the best solution would be to accept what has been proposed by the Liverpool Congress, because the question under consideration has been borne on the order of business of all recent Congresses without any decision having been reached.

The PRESIDENT asks the Meeting to come to a decision.

After more remarks by Messrs. CHARGUÉRAUD, MENGIN-LECREULX and other speakers, the Meeting agrees on the opportuneness of not acting in accordance with the conclusions of the Liverpool Congress and limits itself to drawing up the resolution indicated by Mr. CHARGUÉRAUD.

Hence the Section votes « that it is highly desirable that the « States agree as soon as possible on some uniform legislation ».

The PRESIDENT gives the floor to Captain DE VITO of the Naval Engineers, General Reporter on the second communication : « Transportation of Freight by Ferry-Boats ».

Captain DE VITO makes a rapid summary of his general report and says : 1° That the special technical difficulties of the service of ferry-boats are now completely solved, and that there is nothing to prevent the extension of the use of ferry-boats ; 2° That the installation of ferry lines has a chance for success in accordance with the tonnage to be carried, and this tonnage should be sufficient to allow the utilization of the full capacity

of the ferries and to keep them in continuous service, with an approximately equal traffic in both directions ; 3° That there is a *limiting distance* for the above-mentionel lines beyond which they should not be installed ; this limiting distance is a function of expenses and of the cost of transshipment in the ports to be joined.

Captain De Vito believes that, given the success of this system of navigation, it can be foreseen that its application will be extended to quite long crossings. In America there are ferry-boats which make crossings of 60 miles, and even now the application of these boats is looked forward to between Venice and the ports of the Adriatic and for the crossing of the British Channel.

The same inexorable law of driving progress which forces human activity to cut the isthmuses on the great navigation routes, will also bring about the establishing of lines of ferry-boats to cover, between islands and continents, the straits which interrupt roads and railways.

The Meeting acknowledges the very interesting statement of Captain De Vito without offering any conclusions.

The President, after thanking all the speakers, adjourns the session at 5 P. M.

II[d] SECTION

(Maritime Navigation)

IV[th] SESSION

Friday, September 29, 1905

President :

Commander Ignazio Inglese, Inspector General of the Corps of Civil Engineering at Rome.

The meeting was called to order at 9.15 A. M.

President, Comm. Inglese. — As the order of the day is the question : Improvement of the Mouths of Rivers, the Section will take up the examination of the report prepared by the Committee of which Mr. Vernon-Harcourt is Chairman and the following members : Messrs. L. Luiggi, L. Corthell, Germelmann, Nyssens-Hart, Mengin-Lecreulx, De Timonoff, G. Turazza, Paolo Orlando ; it will then be seen what conclusions can be obtained from this report.

He asks Mr. Vernon-Harcourt to be so kind as to read the report.

Mr. Vernon-Harcourt reads the French text of the report :

« The very great diversity of local-technical, economic and » financial conditions, which Engineers cannot help facing, do » not allow any general and absolute rules to be laid down, at » the present time, for the improvement of rivers emptying into » tideless or nearly tideless seas. Each case may involve a » special solution,and no work of this sort should de undertaken

» without a thorough study not only of present conditions but » of the changes which have occurred in the past.

» This being said, experience has proved that, according to » circumstances, the solution could be sought either by permanent works, that is especially by jetties, or by dredging or by » the two combined.

» As to the method by jetties, the Congress of 1892 gave some » indications in the matter of the natural conditions necessary » for this method by itself to have some chance of success. » These indications have lost none of their value. When it is a » question of a delta, the same Congress gave some advice, about » the arm to be improved, which it would be well to consult.

» There may be added to this, as pointed out in the reports » submitted to the present Congress : —

» 1° That, as a rule, the width and discharge of the selected » arm will have to be reduced to the minimum of what is » necessary for navigation, so as to let the greater part of the » liquid and solid discharges of the river pass off through the » other arms ;

» 2° That the works will have to be so laid out as to lend » themselves to an extension whose necessity in a more a less » distant future can be foreseen ;

» 3° And finally that, in order to secure success, especially if » a bar be in question, the jetties should be built as fast as » possible and their length should be made at once such as to » reach at least to the depth to which the channel is to be » carried.

» As to the method by dredging, the immense improvements » made, in recent years, in the construction and working of » dredging machines, especially by the introduction of suction » dredges, have endowed this method with a power and effectiveness to which the Congress of 1900 did well to call the » attention of Engineers.

» Even when the principal elements of the result are demanded from permanent works, dredging will generally be » necessary to hasten, complete, maintain or finally deepen the » desired channel.

» Dredging may also be used alone whether to open a » long delta hardened by time, or to cross a bar too far out » for jetties to be used in practice ; and even then it may » be necessary to put in auxiliary permanent works to maintain

» acquired results, or to regulate the distribution of the water » at the head of a delta, or to protect the dredged channel » against materials which may be brought in from the sides : » in this case the works should be as low and as simple as » possible.

» In a word, the method of dredging has placed henceforth in » the hands of engineers a simple and powerful weapon, appli- » cable and often preferable in most cases, but which cannot » be considered as absolutely and unlimitedly effective. When » it is desired to force nature, dredging sometimes involves » great permanent sacrifices which the importance of the traffic » must justify. There will even be cases when the extreme » mobility of the bottom, under the influence of maritime » actions, will put this method itself entirely out of reach.

» When, for either financial or technical reasons, the methods » just set forth fail, there will remain to be examined the » construction of a lateral canal opening into the sea at a point » beyond the sphere of action of the mouth.

» There should be made in all cases, and before beginning » any extensive works, a comparative examination of this solu- » tion which, under favorable local conditions, is sure and » simple.

» Signed : Paolo Orlando ;
» L.-F. Vernon-Harcourt, Chairman ;
» Mengin-Lecreulx ;
» De Timonoff ;
» G. Turazza ;
» L. Luiggi ;
» L. Corthell ;
» Germelmann ;
» Nyssens-Hart. »

Mr. Nyssens-Hart remarks in regard to N° 3 that, instead of saying « the length of the jetties should be made at once such » as to reach at least to the depth to which the channel is to be » carried, » it would be better to say that « the jetties should be » so laid out that the energy of the currents should be directed » efficaciously on the bar. »

Mr. Luiggi does not agree with Mr. Nyssens-Hart as to the expression « energy of the currents, » because, in the opinion of

the Italian engineers, and especially of Mr. Cornaglia, very great actions are also caused by waves ; he proposes for adoption the expression : « the energy of the currents and waves. »

After further remarks agreement is had on the expression : « the energy of the natural forces of the water ».

Comm. Inglese, President, thinks that the discussion has been sufficiently long and the propositions set forth in the excellent report of the Committee, to whom he expresses his sincere thanks, will give Engineers valuable data in the different cases arising in practice. He judges, however, that the report, which is quite long, cannot form the conclusions of the Congress ; he asks that conclusions, summing up the principal propositions of the Committee be prepared.

Mr. Luiggi proposes the following which are carried unanimously :

« For the improvement of non-tidal rivers, the system of » jetties is to be recommended so long as the distance between » the bar and the shore does not lead to excessive cost.

» In the contrary case, and especially for deltas which have » become firm in the course of years, dredging, since the » adoption of suction dredges, offers an excellent solution of » the problem, provided that the amount of traffic justifies the » expense involved in dredging.

» Dredging is useful, in certain cases, to hasten or complete » the action of jetties ; should neither of these systems be » suitable, the lateral canal, having its outlet placed beyond » the action of the delta, would offer a simple and certain » solution. »

The President brings up for discussion Question IV : « Con- » struction of breakwaters outside of ports attention being paid » to the power of the waves which they must withstand. Deter- » mination of this power », and gives the floor to the General Reporter, Mr. Logatto.

It is found better to discuss first the part of the question relating to the determination of the force of waves.

Mr. Logatto reads the following conclusion :

« The power of waves and the essentially dynamic efforts » which they bring to bear on outside breakwaters are beyond » any exact measurement. The effects of destruction on works » in the sea are due to a repetition of dynamic efforts, which » repetition is not suceptible of any preliminary measurement. » In projects for new works in the open sea, the engineer can » only resort to an examination of existing works by taking into » comparative consideration the regimen of the sea in the » approaches to the port, and every other condition which may » give him useful elements on which to work. »

Don Jules Valdes y Hamaran agrees with the General Reporter in his first two conclusions ; he states however that the repetition of efforts is far from keeping up constant actions ; on the contrary, the intensity of these actions is successively very variable. According to the observations of Mr. Félix Laroche, Mr. Addone Bernardini and himself, the greatest shocks are only caused successively on restricted portions and at points quite far apart ; it follows that, by reason of the continuity of the masonry, the parts which are struck hardest are supported by adjoining parts which are less tried and this increases the strength of the work.

As to the third conclusion, he considers that, in the preparation of new projects, the engineer should not confine himself to the mere examination of existing structures and of the local regime, that is : he should resort only to empirical processes of comparison ; but he should, on the contrary, undertake a conscientious calculation of the form of the profile, not alone to settle the full strength of the work, but to obtain valuable ideas for the inside arrangement of the materials and for the setting of the parts of the strcture with regard to each other. If this process had always been followed, there would surely have been avoided serious accidents and even catastrophies of which the explanation can easily be found, however, by analytical calculations.

As against this it will be said, perhaps, that the point of departure for any calculation, that is : the power of the waves, is unknown, or at least it cannot be determined exactly. But if exact values are not known, there are sufficient indications in the values of the dynamic pressures as found by dynamo-

meters. He considers that pressures of 30 tons per square metre, although this figure is rather below what have been found sometimes as MAXIMA by more or less accurate instruments, may be taken as bases for calculations, especially if the preceding remark about the support given by the parts of the work not touched by the wave to those which receive its force be taken into consideration.

By working in this way the engineer will be sure that the work will be strong enough for all cases, even for the most unfavorable local conditions ; if these conditions be favorable, they will help to increase the strength of the work.

Mr. LOGATTO, General Reporter repeats, in answering Mr. Valdes, that the repetition of the efforts of the waves on the work cannot be considered in the calculations, this repetition being generally the determining cause of the damages. Even if this repetition could be valued in any way, this element could by no means be introduced into the formulæ ; this is why he considers the empirical method of comparison as being of very great importance.

Mr. LUIGGI says that the question lies rather in the expression used by the General Reporter and perhaps not accurately rendered in the French text of the general report. He thinks that it might very well have been said : « In projects for new works » in the open sea, the Engineer will find most valuable infor- » mation by the examination of existing works, &c. ». In this way the engineer is not shut off from being able also to resort to analytical calculations if he has sufficient data.

Mr. VERNON-HARCOURT says that there exists, in fact, no way for measuring the force of waves on works. He thinks that observations on the force of waves during storms, made at different points along the coast by an improved dynamometer, which perhaps will be found, simultaneously with records of the wind pressures at the same points, would have considerable value. Such observations would form the bases of a scientific study of the power of waves in its relations to the situation of the points considered and to the force and direction of the wind. However, with our present knowledge, we must — as does the

General Reporter himself — grant the greatest importance to the empirical method of comparison of local conditions, viz : depth of the sea, distance from shore, direction of the most dangerous winds, formation of the coast. In this way will be avoided the repetition of the blunder made, in 1849, by the engineers who, building the d'Aurigny breakwater, which fronts the Ocean, patterned it after the one at Saint-Catherine, on the East shore of the Island of Jersey where it is well protected by the adjacent French Coast.

Mr. Coen-Cagli. — I wish to say a few words on this first part of the question now under discussion. The General Reporter mentions an application of ordinary formulæ which I made at the new Naples breakwater. Doubtless the resulting effort is by no means remarkable, as the General Reporter says ; but I only gave this result as an application of formulæ given, on the basis of a new theory, by one of our most honored recent scientists, the regretted Inspector General Paul Cornaglia of the Corps of Civil Engineering, of whom Mr. Luiggi has already spoken, at our first session, in conection with the improvement of the mouths of rivers. In my opinion, this theory is very valuable as a contribution to the researches on the laws of the propagation of waves and on their effects on obstacles, and it deserves to be better known than it is.

Colonel Emy had deduced, although in a way that was erroneous, from the mechanism of the circular motion of liquid molecules, his conception of the bottom wave, which he considered as the result of the opposition, brought into play by some sharp elevation of the bottom of the sea, to the development of the orbital motion of the liquid mass. A large contribution of observations and remarks was made to the theory of the *bottom wave* by Commander Cialdi ; but it was Mr. Cornaglia who reconstructed the theory enunciated by Colonel Emy on much broader and more rigorous principles, by showing that, in order to generate the wave, the mere slope of the bottom was sufficient without the intervention of any sharp elevation, and that this wave, self generated — at least in heavy storms — at the very foot of the slope, must, by following the movement of the surface waves toward the shore, increase and accumulate its energy all the time along the bottom until it breaks with all its violence

at the furthest edge of the water. Taking this theory as a foundation, Mr. CORNAGLIA also succeeded, by a very ingenious and bold mathematical analysis, in developing formulæ for calculating, in functions of the elements of the wave and the cross-section of the bottom, the velocity of the wave at any point of its course and consquently also *at the site* of the obstacles represented by breakwaters, thus giving to engineers the essential item necessary for calculating the strength of the defensive works of ports, an item which had always escaped their investigations.

If no direct observation have yet allowed the exactness of Mr. CORNAGLIA'S theory or the correspondence between the rsults given by his formulæ and the reality of the phenomena to be checked, it is possible, however, to obtain a general confirmation by the laws which govern the movement of materials along the beach, and these laws harmonize perfectly with the deductions, which are drawn logically from the principles expressed by this eminent man on the formation of bottom waves, and to note in a few cases an agreement between the velocity of the wave calculated by his formulæ, and that deduced from the effects actually produced on works by the waves of storms.

Now, it seems to me, that the question of the origin and propagation of these formidable movements of the sea whose energy we should like much to know, deserves the greatest attention from the Congress.

So, while not not assenting to what is absolute in the conclusion proposed by the General Reporter, viz., that the power of waves and the dynamic efforts which they exert on the outside breakwaters of ports *are beyond* any exact measurement *(échappent à toute mesure précise)*, I must admit that we do not yet posses sufficiently sure means for measuring these effects. There is little confidence to be placed in the different formulæ because they are all founded on more or less arbitrary hypotheses. Nor can the results of experience give exact data, not even for the work which may have furnished these results through some great injury, because it cannot be know in what order these damages were caused under the reiterated action of the waves or what was the state of the work when the last blow was received. And then the formulæ and coefficients which are

finally used to work back from effect to cause are always very uncertain.

The method by the use of the dynamometer has been much improved recently by Major GAILLARD, of the Corps of Engineers of the U. S. Army, who is the inventor of a new dynamometer and also the author of a very remarkable work on the action of waves on detached breakwaters, about which Mr. DYCE CAY has given information in his report. The greatest trouble with the STEVENSON dynamometer lay in this that the effort could be either diminished by the counterpressure on the back of the plate, or increased by the *inertia* of the plate and the rods set in motion as a result of the shock. Major GAILLARD'S dynamometer is one with diaphragms, that is to say, a cylinder having an elastic bottom and filled with a liquid which communicates with a gauge. Considering, on the one side, the essentially dynamic nature of the stresses exerted by the waves and, on the other, the small surface represented by one of these mechanisms as compared with the mass of water synchronically in motion, I doubt greatly whether the indications of this instrument can be very near the truth ; but I do think that, as a means of comparison, the use of perfected dynamometers might give — as Mr. VERNON-HARCOURT also says — very useful data, and assist especially in giving us clear information on a very important point, on which opinions are greatly divided, namely, the depth at which the surface motion is propagated sensibly.

I have given, in my report, my personal opinion as to this. One of the most noticeable facts in the destructive power of waves is the sometimes enormous disproportion between the effects produced by a heavy sea, and the kinetic and potential energy of the waves at their surface. Major GAILLARD shows, it is true, that the force of waves in great storms, calculated from the quantity of motion, may reach very high values which could justify fully their destructive effects, but this power only concerns the crest of the wave and, consequently, cannot represent in any way the average force of the wave on the entire surface of the portion of the work attacked.

This disproportion can only be explained, it seems to me, by assuming that there is produced, at the site of breakwaters, a real concentration of the forces distributed throughout the depth of the water, that is to say, that, to the force of the surface

Naples. — Posilippo.

waves, should be added the internal forces developed in the lower strata of the liquid, whatever be its true form.

The direct consequence of this principle is that the modern cross section of breakwaters with vertical walls seems to be the most rational, and that we should try to carry the superstructure with vertical walls to the greatest possible depth ; in this way the concentration of efforts is reduced to a minimum, and consequently the specific resistance of the structure exposed to the shock is raised to a maximum ; at the same time the recoil of the wave at the foot of the structure is reduced to a minimum, with corresponding gain for the solidity of the work.

Finally, and in what touches the determination of the force of waves, it seems to me that the Congress, while recognizing that we have not yet, unfortunately, sufficiently sure means for determining the force of waves, should not say that it is impossible to accomplish this feat some day, but rather should it encourage investigators to continue their researches either by the way of theory or especially by the way of experiment.

Human genius, which has been able to determine the motions of the stars, may also, some day, measure the power of waves. *(Loud applause.)*

Mr. Logatto, General Reporter, answers that he did not say in his conclusion that the power of waves « will always be » beyond » but only that « it is beyond any measurement. » He did not judge the future. He does not object to having the conclusion modified in the way stated by Mr. Coen-Cagli, by saying that the power of waves « has been until now beyond » any exact measurement ; which, so far as he is concerned, is of no importance.

Mr. De Thierry accepts the text proposed by Mr. Logatto.

Mr. Inglese, President. — Taking together the different remarks made by members of the Congress on the three conclusions of the General Reporter, he thinks that the Section will perhaps agree on the following changes :

« The power of waves and the essentially dynamic efforts » which they bring to bear on outside breakwaters have been » until now beyond any exact measurement.

» The effects of destruction on works in the sea are due to » a repetition of dynamic efforts which, in like manner, it » has been so far impossible to determine.

» In projects for new works in the open sea, the engineer » will find most valuable information by examining existing » works, by taking into comparative consideration the regimen » of the swell outside, the shape of the shores and the lay of » the bed of the sea in the approaches to the port, and every » other condition which may give him useful elements on » which to work. »

These conclusions are adopted unanimously by the Meeting.

The General Reporter then reads his conclusions on the second part of the question : « Construction of breakwaters out- » side of ports, in connection with the power of the waves they » have to withstand. »

« Rip-rap breakwaters, although expensive to maintain, are » suited to very sheltered shores and to rather shoal water, if » cheap and good materials be at hand, and if they be not » affected by the muddy character of the bottom.

» When works are exposed to very heavy seas, resort may » still be had to rip-rap under the above-mentioned conditions, » by adding on the sea side — and out to a certain depth — a » revetment of concrete blocks. The arrangement of these » blocks which seems to be the best, from the point of view of » strength and maintenance, is to drop them pell-mell into » place, save for studying suitably the profile of the revetment » so as to cut the wave at the level of the sea ; the careful » placing of the blocks offers, on the contrary, serious difficul- » ties. It may be broken up by settlements of the rip-rap and » totally destroyed in case of severe storms ; in any case it » cannot be kept in repair without abandoning the very prin- » ciple of the system, as was proved by the damage to the » Genoa breakwater at the time of the great blow of November » 1898.

» Breakwaters having a nucleus of rubble stone revetted on » both sides with carefully laid blocks offer no security against » very heavy seas, as shown by the accidents at Leghorn and » Civita-Vecchia, whereas this type may render good service in » sheltered parts of the coast and in moderate depths, especially » if it be a question of unimportant works.

» Breakwaters with vertical or nearly vertical faces are » especially suited for moderate depths on hard bottoms, where » scours are not to be feared from the recoil of the wave or » from currents. Resort may be had in their construction to » masonry laid by compressed air on fairly sheltered shores : » or, through lack of this condition, to great bags of concrete » sunk from scows, or to the very regular laying of concrete » blocks set by means of Titans and with close joints ; all these » systems involve great cost and cannot be used for unim- » portant works.

» Mixed breakwaters with rip-rap substructure and super- » structure of vertical faces, are particularly suited to tidal » seas or seas where the tides are small if the depth of water » be great.

» The construction of the superstructure presents no diffi- » culty in tidal seas if it begin at the level of the water.

» Where the tides are small, resort may be had, on sheltered » parts of the coast, to laying the superstructure entirely with » carefully set blocks, after the type adopted for the new break- » water at Naples. In case of very heavy seas, this type is not » sufficiently secure and can be replaced advantageously, in a » few cases, by large monolithic caissons of the sort used at » Bizerta, care being taken so to adjust the width of the blocks » to their length as to obtain the most perfect compactness of » the random stone, and to counterbalance the much dreaded » effects of the recoil produced, on the outside, at the foot of » the blocks by the shock of waves, either by the use of selected » materials in the upper part of the outer risberm, or by » loading down and defending this risberm by means of pro- » tection blocks at the foot of the caissons. »

Mr. De Joly. — I have asked for the floor in order to offer a few remarks on the general report and to complete my own report in what touches the Bizerta breakwaters.

I have to thank M. Logatto for the analysis which he has been so kind as to make of my report ; but I shall ask his permission to rectify a few points which, perhaps through an error of translation, do not seem to me to be quite accurate.

There is nothing didactic in my report. I have only stated what has been done in France and told with what success.

I made intentionally, a distinction between the breakwaters of the Channel and the Ocean ports and those of the Mediterranean ports. Mr. LOGATTO has not been led, in his general report, to separate tidal from non-tidal seas, and hence, some of the observations taken from my report have a meaning which it was not intended that they should have.

Thus, for example, I stated that rip-rap breakwaters were inadmissible on unsheltered coasts, but only on tidal seas. The history of the great work at Cherbourg shows that it became obligatory to build it in accordance with a mixed type having a vertical wall on a rip-rap foundation, seeing that it was impossible to maintain an inclined slope made of random stone and natural blocks between the levels of the lowest and highest water. This difficulty disappears in the Mediterranean. There is no fundamental distinction to be made between breakwaters built of rip-rap and natural blocks and those made of rip-rap and artificial blocks. Natural and artificial blocks have each their partisans ; the former are, for equal volumes, the heavier, they resist chemical action and wear and tear better, but as a rule they are insufficient when the violence of the waves renders it necessary to make the revetment blocks very heavy. Quartzite blocks of 30 tons, such as are used at Cherbourg, are not to be found everywhere ! Artificial blocks, put in place with the precautions mentioned in my report, may be considered as better seated.

The French translation of the general report makes me say that mixed breakwaters with a vertical superstructure, begun at the level of low tide, was required for very exposed shores on tidal seas. I said only that this type of work had been uniformly adopted at the French ports of the Channel and the Ocean ; but I was careful to add that on shores exposed to exceptionally heavy seas, like those at the bottom of the Gulf of Gascony, the type might become insufficient or at least uneconomical, and I mentioned the examples of Bilbao and Saint Jean de Luz. I do not, for this reason, any the less consider this type as the normal one on the French coasts of the Ocean and the Channel. It has given excellent results at the West breakwater at Cherbourg, which is to be prolonged with the same cross section,and it is interesting to compare the cost per running metre of the Carnot breakwater at Boulogne (6000 francs) with those of the Dover breakwaters built according to the vertical

type in average depths slightly greater than those found at Boulogne, but with the same tidal conditions and equivalent or better exposure. Mr. VERNON-HARCOURT puts this cost at 30,488 francs for the jetties of the military port, and 12,000 fcs for the East jetty, built partly of open work ; and yet, according to a report of Mr. Mathews at the Saint-Louis Congress, the waves have never exceeded 13 feet since work was begun on the new port.

Finally, in opposition to Mr. COEN-CAGLI'S opinion about laying carefully placed blocks with broken joints, Mr. LOGATTO has used the observation which I made about the Agha breakwater where these blocks are set in independent columns. I think that I must here recall the fact that settlements are to be feared at Algiers by reason of the height of the rip-rap core and of the mudlike character of the ground, and furthermore that the shell of carefully laid blocks of the Agha is protected on the seaward side by a line of blocks which are simply thrown in. The arrangement of regularly laid blocks adopted at the Agha would not seem to me to be fully justified under different circumstances.

I come now to the Bizerta breakwaters. My report tells about the effects produced on the works by the storms of 1904, including the one of the latter part of November ; it can be seen from this report that something will follow these effects, but it cannot say what this will be. The reporters of the Congress received, toward the end of last year, pressing letters from our eminent Secretary General who insisted upon receiving their work before December 31 ; I sent mine in on the 28th. Our colleagues, Messrs. NYSSENS-HART and PIENS, who, if they presented no report on the question under discussion, prepared a very interesting communication on the port of Zeebrugge, must have done the same. But if the « Quos ego » of Mr. DUFOURNY could cut short the whims of delay of certain reporters, they did not arrest the storms on the Mediterranean, or even on the Belgian Coasts. December 31, the day of fatal settlement, saw a storm which, it appears, made a breach in the outside defence and in the inner quay wall at Zeebrugge: I trust that one of our Belgian colleagues will give us some information about this accident and will tell us not only how the big blocks acted, but also the rip-rap and fascine work of the substructure.

Great damage was done at Bizerta, on January 28, 1905, by a storm from the N. and N.-N.-E.

This storm exceeded in violence all that had gone before, because it dislocated a great length of the North breakwater which had been built by the Company which had the concession for the port from 1889 to 1895, and which, in spite of the weakness of its profile and the poor quality of the natural blocks of the revetments, had stood well for 10 years, as stated in my report. The natural blocks and rip-rap were carried out to sea and the overhanging masonry superstructure was split lengthwise. An almost complete rebuilding of the upper works was necessary ; it seems to have been carried out along the lines adopted for the extension of the great jetty at Oran.

The breakwater built by the Navy between 1899 and 1904, of a mixed type, with monolithic blocks of 5000 tons, suffered less; still it was much damaged both in the substructure and in the vertical wall which surmounts it. The outside risberm of large natural rip-rap blocks, which protected the foot of the monolithic blocks and which had scarcely been disturbed by former storms, was thrown out of order ; the heavy rip-rap was carried away completely by the recoil wave and fell so as to reduce the slope of the substructure to 3/1. Important cracks and settlements were made in the vertical wall : the concrete in the joints between the 5000-ton blocks disappeared entirely and, where these joints were, the masonry superstructure showed real triangular breaches. Some of the settlements of the large blocks are vertical, others are accompaned with movements towards the harbor side. These transverse movements are especially marked in four blocks situated near the south end of the breakwater ; one of them amounts to as much as a metre.

The extension of the north jetty, built by the Navy with a cross-section similar to that of the breakwater, acted better. The outside risberm of the substructure was stripped and the great artificial blocks settled a little ; but the latter, which had not yet been bound together by concrete joints, were not disturbed.

The strength of the storm of January 28 showed still better than that of the preceding storms that :

the danger of the recoil which takes place at the foot of the

great 5000-ton blocks of the Bizerta cross-section, still further raised by a superstructure of perhaps excessive height ;

the disadvantage of binding these blocks together after laying them.

The fissures through which the waves were able to tear off a few portions of the masonry, are due mainly to the masonry having given way to the straims produced at points where adjacent blocks came into contact.

It is also evident that the poor quality of the rip-rap and of the natural blocks obtained from the quarries near Bizerta contributed toward the settlement and injuries to the substructure.

In view of the urgency of the case, large natural blocks from this same source were used, nevertheless, in 1905 for reloading the outside risberms ; they form a first bed which will be inclosed later with large natural blocks of hard stone and with artificial blocks of 33 tons. The new revetment of the substructure will be moved out to 12 to 15 metres in front of the foot of the vertical wall ; its surface will have a slope proportioned to that of the substructure as dressed down by the waves. The inside risberm will be raised greatly at the point where the blocks were thrown out of place, in order to oppose their tendency to overturning.

The making over of the masonry of the blocks or of the substructure will be also carried on by taking great care to keep the corresponding parts of blocks entirely independent of each other.

Such are the lessons that I can give to the Congress on the present state of the new jetties at Bizerta. May they help to cast light on the conditions for use of big monolithic blocks which, if one may judge by the reports presented on the fourth question, are occupying much of the attention of maritime Engineers.

Mr. Logatto, General Reporter. — In the matter of Mr. De Joly's remarks about my general report I wish to observe :

a) As to laying blocks with broken joints, I said in my report, that as this mode of laying « does not allow the blocks to follow » the settlements due to the height of the rip-rap core and some- » times to the mudlike character of the bottom it becomes the » cause of flexions and interior reactions » &c.; and that such

is Mr. De Joly's opinion. Now, he has said this in connection with the Agha breakwater at Algiers ; and the general truth of what I advanced is not lessened, because it is a question here of *mixed breakwaters with a rip-rap substructure and a superstructure*, and for these structures the height of the rip-rap core should be always considered and frequently the mudlike character of the bottom. If there were no rip-rap substructure, the laying of the blocks with broken joints would be as good as building them up in independent piers.

b) The distinction which I have been led to make between rip-rap of natural blocks and jetties made of concrete blocks, was suggested by the difference between the two systems of laying these blocks *(pell-mell and regularly)*, and regularity is only possible with concrete blocks. Furthermore, concrete blocks which are always regular in shape and of constant volume for a given work, cannot be considered as are the natural blocks whose shapes are irregular and their volumes very variable, and these latter blocks give a compact structure which cannot be had with the concrete blocks.

Mr. N. Dyce-Cay. — In studying the excellent reports, presented to the Congress, on breakwaters built with rip-rap or random stone foundations, there is found to be a discussion, carried on with all the resources of science and experience, directed toward trying to erect a good structure on a bad foundation.

We are now all agreed that this foundation is bad,. Loose stones in the sea may be compared to a lightly deposited pile of coal on shore, whereon nobody would build, especially if the structure would be exposed to powerful forces like those of the waves.

I hope that the Section will pronounce against the continued use of this sort of base hereafter.

But if, all the same, there is nothing to do but use this system, I think that, instead of placing vertical walls above the rip-rap, it would be better to increase the height and width of the rip-rap bank and protect it with big blocks, bags of concrete or concrete cylinders with rounded ends, all placed as a revetment on the slope.

I recognize the difficulties of working without small stone in great depths, of 30 metres as at Genoa or Naples, and I shall

mention a system which I have tried while making the foundations for piers of large bridges. It is a question of using cast-iron cylinders for these bridges. The cylinders are stood on the bottom, then the earth is dredged out from the inside, without removing the water, and their descent is assisted by adding weights ; when they are down to their bearings the bottom is sealed up with concrete laid under water, then the cylinders are emptied with a pump and the filling is continued dry.

In order to apply this system to the foundation of a breakwater in 30 metres (98.40 feet) of depth, I should use cast iron cylinders 3.50 m. in diameter which I would fill with concrete to a height of 22.50 m. above the bottom, after having surrounded them with rip-rap. I should then remove the part of the cylinder above the concrete and the foundation would be ready to receive the masonry superstructure.

Concrete could be used for the cylinders instead of cast iron, as has been done sometimes in founding quay walls (as at Glasgow, for example).

As to my method of making foundations with concrete in bags, it is described in my report to the Congress ; I wish merely to add that the Aberdeen works mentioned therein cost in all, inclusive of cost of installation, derricks, scaffolds built in the sea, reclaiming of land &c., about 50 francs per cubic metre of concrete in place (= $ 8.00 per cubic yard approximately).

I also mentioned in my report a system used in Scotland for building below water with fresh concrete, and I wish to mention especially the Buckie works and those for the extension of the breakwater of the old port of Wick, about which I was consulted and which were directed by one of my assistants. As said in my report, the dose of cement in the concrete was much greater than usual (1 of cement, 1 of sand and 2 of broken stone); but this outlay was balanced by the less cost of machinery and installations. In order to place soft concrete in place, drop-bottom boxes of 9 tons capacity were used. These works were very successful ; they were built 35 yars ago. Mr. Vernon-Harcourt also gives, in his report, a description of a small work which he built in this way ; but I do not think that he claims to have been the first to use the system of which I made a trial myself in 1870. Although this system is good, care must be had as to the place and way of working, otherwise layers of

« laitance » may form and interfere with the setting of the concrete.

As for the superstructure, I hope that the Section will consider the vertical wall as best. I have always given a batter of 1/8 to the sides ; in some cases it might be preferable to increase this to 1/4 so as not to inclose too great a quantity of air between the advancing wave and the work, as this would cause the throwing upward of great jets of water.

As to the system of construction for the superstructure, I have nothing new to say, so I shall do no more than mention the various types, viz. : —

1° Structure of big blocks, surmounted by a monolithic mass of concrete masonry ;

2° Structure of bags of concrete with top monolothic mass ;

3° Wholly monolithic structure ;

4° Floating blocks or caissons as at Zeebrugge, Bilbao, Bizerta;

5° Coffer-dam blocks, adopted for new breakwaters in Denmark ;

6° Cylindrical blocks of 100 to 200 tons in place, of which models have been shown.

Don Julio Valdès y Hamaran, Assistant Director of the Port of Barcelona. — I express to the Congress, in my own name and in that of my colleagues of the Spanish Delegation, our satisfaction in the matter of the important general report presented by Mr. Logatto, and of the other very interesting articles presented by the other reporters. It would not be possible, indeed, to state more tersely and at the same time more precisely the present state of the technique of this very difficult sort of constructions. I express also our satisfaction in this that, at the port of Barcelona which, every one knows, is the first in Spain in importance of traffic, there is under construction to-day a breakwater whose project, aproved in 1903, not only rests entirely on the principles pointed out in the conclusions of the honorable General Reporter, but also presents a whole which is harmonious in all its parts by giving to each an exact and very important role to fulfil.

The idea of this type of breakwater is derived from the type of the one built so successfully by Mr. Carrucha, Engineer at the port of Bilbao, after a violent storm had carried away the superstructure resting on a mass of big concrete blocks thrown

in at random. Mr. Carrucha, instead of abandoning the mass entirely, counted upon its assistance in rebuilding, further inside, the breakwater composed of monolithic caissons. In this way the cross-section of the new structure could be reduced.

At Barcelona, where resort had necessarily to be had to safe systems, depths of 16 to 20 metres being in question, the Bilbao type was imitated, and the arrangements of the work are, in few words, as follows :

A rip-rap substructure is levelled off on the outside at 6 metres below the water surface. A mass of big 80-ton concrete blocks thrown in at random, rises as a superstructure on the outside from 9 metres below to 2 metres above the level of the sea. Inside there is a wall composed of monolithic caissons, forming — according to the conclusions of the General Reporter which have just been read — the last word in this sort of works ; between the outer work and the caissons a rip-rap filling of big natural blocks connects, so to speak, the two works and is loaded down by a double tier of concrete guard blocks set so as to break joints.

The quay and the shelter wall of the breakwater rest on the monolithic caissons.

The advantages offered by this type are mainly as follows :

1° Obtaining quickly a shelter on the body of the work and in the harbor through the outer work of blocks thrown in at random ;

2° Safety and ease of work in placing the monolithic blocks by reason of the shelter given by the said outer work ;

3° Great reduction in the time necessary for the construction of the work ;

4° Reduction of risk of injury and damage during construction ;

5° Marked reduction in the net cost.

I ask the attention of the Congress to the construction, transportation and placing of the monolithic caissons. As a matter of fact, these caissons could be made of concrete with several compartiments, without any metallic stiffening either inside or outside, and by very simple methods which were perfected, naturally, as the work went on. The following dimensions were adopted as the most suitable : —

Width 6 metres, height 7 m., length 14 m.; still it is believed that the system would be perfectly applicable with larger

dimensions. Furthermore the net cost per unit would be less as the use of cement and the cost of transportation of the blocks, which are inversely proportional to the volume of the latter, would be reduced.

The result with us was that the total cost per cubic metre of concrete in place amounted to only 28 francs (= $ 4.43 per cubic yard approximately) ; that is to about half the price attained in the French and Belgian ports.

These caissons were put afloat very easily by means of the depositing floating dock in possession of the Commission for the Works of the Port of Barcelona, and their transportation afloat was had by any tug.

They were easily placed by setting suitable supports on the bottom and by manœuvring in the bottom of the caissons valves worked by vertical rods ; these valves let the caisson be sunk regularly and without the least danger.

In each caisson, water was introduced into the centre compartments and not into those at the ends which are filled, free from water, with concrete or with masonry if this be preferred.

When a caisson is set and ballasted by filling the extreme compartments, the water is pumped out of the centre compartments which are then filled dry until the caisson is filled solid. In order to hasten the placing of the concrete, we use iron drop-bottom boxes containing 10 cubic metres, which were filled from the concrete mixers and carried by a floating derrick to the edge of the caisson.

For a few caissons, blocks which were at hand were used in the concrete mass ; but that is only an expedient which is by no means necessary and generally not to be recommended ; on the contrary, it is better to obtain wholly homogeneous and monolithic masses by filling the compartments with concrete.

Such in few words is the new type of breakwater which we offer for the consideration of the Congress and whose advantages will surely appear to the engineers who are engaged on these difficult constructions.

Consequently I have the honor to propose, in the name of Mr. Don Carlos De Angulo y Bertram, Director of the Works of the Port of Barcelona and in my own personal name, the following conclusion to be adopted by the Congress :

The type of breakwater selected for the new works of the port of Barcelona may be considered as acceptable in all cases where

the power of the waves is included between the limits of 15 and 20 tons pressure per square metre ; it is to be recommended for its ease of execution, its stability and its really remarkably low net cost, which, in average depths of 16 metres, is included between 11,000 and 12,000 francs per running metre (= $ 645 and $ 705 per running foot) of the work.

(Loud applause.)

Mr. Coen Cagli. — I have asked for the floor in order to make a few general remarks on the conclusions of the General Reporter :

On the first conclusion, referring to rip-rap breakwaters.

I held in my report that this type may be replaced, generally, by the mixed type. This refers only to very important breakwaters. I would propose saying, finally, « that rip-rap is suited for unimportant jetties , which also applies to sheltered parts of the shore and small depths of water.

As to the *second conclusion*, I find that it is just and conforms to Mr. De Joly's report, but, as a rational type is sought, I think that we may not set aside the first cost and the cost of repairs. Both are enormous in the type proposed by the General Reporter.

It was just in order to reduce this cost of maintenance that Mr. Parodi, Inspector of the Corps of Civil Engineering, proposed in 1879, for the first time, to replace the revetment of blocs thrown in at random, with a revetment of blocks carefully laid. I agree perfectly with the General Reporter as to the poor results given by this latter system of revetment.

In the discussion on the preference to be given to the type with vertical walls on top of rip-rap,as compared to the simple rip-rap type, the General Reporter attributes to me an underlined *always* whose paternity I cannot recognize. I have considered only works of great importance ; I think that for these works the rip-rap type can be replaced advantageously by the type with vertical walls on rip-rap, consideration being paid to the way in which the sea acts against obstacles.

I have also confirmed fully the conclusions of preceding Congresses, that is : that the choice of the system depends on a large number of very variable local circumstances.

The General Reporter, after having done the Naples breakwater the honor of raising it to the grade of a *type*, takes away all honor from it by adding that this type can only be adopted in little exposed localities. I should be glad to have the opinion of the Meeting on this point.

Mr. Vernon-Harcourt. — Gentlemen, I agree perfectly with the greater part of the conclusions of the General Reporter. There is only one point on which I do not wholly share his opinion : I do not think that, in the mixed type, the masonry superstructure surmounting the rip-rap substructure can be limited to the low water level and consequently offer no difficulty in construction, as the General Reporter has said. In England a lower level than this has generally been taken : but in a few cases a vicious system has been adopted for this superstructure, and discomfitures have been met with. Thus on one occasion two walls were tried with a filling of stones between them. They did not resist at all ; the breakwater was destroyed. There should have been one single mass instead of two walls. In England, for the Atlantic coast, the superstructure has been carried down nearly to 6 metres below the lowest water. Personally, I think that it is better to go even lower, perhaps to 10 metres below low water.

As to the comparison made by Mr. De Joly between the cost per running metre of the Carnot breakwater at Boulogne, whose superstructure is founded at the level of low tide (6,000 francs per running metre), and that of the two jetties at Dover which amounts, according to data furnished by myself, to 30,448 fcs for the military port and 12,000 fcs for the East jetty, I must say that, in my opinion, these jetties cost too dear. The fact that the exposure of the Channel is very different from that of the Atlantic was not sufficiently considered ; furthermore the Government engineers did things very largely without troubling themselves too much about expenses. I think that the Engineer's duty is to build solidly, but he should also not spend more than is necessary.

Mr. Batard-Razelière, Chief Engineer of the Ponts et Chaussées. — The worth of the system of construction consisting of a core of natural rip-rap protected on the sea side by a revet-

ment of artificial blocks has just been disputed ; allow me to make a few additional explanations on this system which has been used successfully for some sixty years on the great breakwater of the port of Marseilles, over a total length of more than four kilometres (= 2 1/2 miles) and in depths varying from 10 to 30 metres. These considerations will also support the conclusions of the honorable General Reporter. I begin by saying that I shall take care not to lay down any determined type of jetty to the exclusion of all others, for the reason that the solution to be adopted for each special case depends on local conditions which have an influence, necessarily on the arrangement and dimensions of the cross-section ; but I am convinced that the Marseilles type can answer admirably well the greater part of the cases which can arise in Mediterranean ports, by simply modifying, be it understood, as necessities arise, the artificial block revetment as well as the classification and the way of laying the natural rip-rap. It is with intention that I say nothing about the Ocean ports, where it is wholly natural that advantage should be taken of the play of the tide to build in the open air as a monolith the part of the breakwater which rises above low water, and where the rip-rap core is merely a foundation.

I consider in the first place that the type in question is certainly of the most rational character because the exterior slope below the level of the water is made up of materials of which the individual mass varies progressively in the same direction as does the action of the waves on the slope. At Marseilles for example, on the last section built, the artificial 14 cubic-metre blocks, weighing about 33 tons extend down to 6 and 10 metres below the water level, those of 1300 to 3900 kilos (= 2860 to 8580 lbs) lie between 10 and 14 metres below and finally those of 100 to 1300 kilos (=220 to 2860 lbs) below 14 metres. The small stone, spalls and refuse are reserved for the centre of the mass and for the foot of the interior slope.

This formation of the mass makes it necessary to divide the natural rip-rap into a certain number of classes corresponding to the different sizes. But this sorting is ordered, in the quarry itself, by the way of loading the materials, which is done by means of derricks for the blocks, the small stone is loaded by hand, and the spalls and refuse with the shovel : hence it involves no special attention. The classification of the materials

also offers the advantage of obtaining an appreciable economy by the increase of the volume of voids.

It seems useful also to call attention to the laying of the artificial blocks which form the revetment. When the expression « blocks laid pell-mell » is used, it must not be thought that the best arrangement is that which is given over to chance. It is, in my opinion, of great importance that the blocks should be set one by one with a floating shear legs, so that their largest dimension shall be laid perpendicular to the line of the work, and that they shall be as close to each other as possible.

The fewer voids there are in the revetment the better are the chances for stability and duration. The sea then takes upon itself the care of obtaining the irregularity needed to wear out the power of the waves.

It is this thought which led the engineers of the port of Cette to build the revetment of the extension of the breakwater beyond 4 metres below the water surface with semi-coursed artificial blocks *(blocs artificiels à demi-arrimés)*, and they have only to feel happy over the result.

It is also essential to make a risberm of natural blocks of the largest size in front of the revetment, and to watch carefully over its preservation so as to prevent the artificial blocks from falling to the foot of the slopes. Finally, to close, I shall add that this type of breakwater may be considered as the most economical in the matter of construction on all shores where there is plenty of stone, where the depth of the water is not excessive and where provision is to be made for a broad quay on a rip-rap embankment behind the work.

Mr. Nyssens-Hart. — Gentlemen, — Mr. De Joly, who has given us a most interesting account of the Bizerta breakwater, calls for one of the Belgian engineers here present to tell the Meeting what took place on the night of December 30 and 31 1904 at Zeebrugge, how the accident to the great breakwater was brought about and what were its consequences.

I think that I can reply to this call of Mr. De Joly and I hope that what I say may interest the Meeting.

So far as Zeebrugge is concerned the case is the same as the one which Mr. De Joly has mentioned at Bizerta.

That report on the works at Zeebrugge, having been handed in on December 30, could not take into account the storm which

raged on December 31 and which inflicted serious damage on the works. There is however between the case of Bizerta and that of Zeebrugge an essential difference to which attention must be called. The breakwater at Bizerta was built several years ago ; its condition had become definitive : at Zeebrugge, on the contrary, the sea surprised the work in course of construction before it had acquired its definitive state of stability.

It is well known that the Zeebrugge breakwater forms a great curve outward of nearly 2 1/2 kilometres (= 1.56 miles) in length. For about 1800 metres the sea wall, formed of masses 7.50 m. thick resting on a rip-rap substructure, is buttressed all along the back by a terreplein 77 metres wide retained by a quay wall on the inside face.

At the extreme end, where the quay wall no larger exists, the thickness of the breakwater is increased to 9 metres.

But this last part was not yet built, and the accident took place in the part of only 7.50 metres.

The 4500 tons caissons had been placed with their superstructures out to and including N° 50 ; N^{os} 51 and 52 had also been placed but their superstructure was not finished.

The contractors had begun, in view of lying off for the winter, to furnish, behind the caisson, the interior risberm of foundation rip-rap.

But this work was interrupted by the storm. The latter breaking over the wall, must have washed out, on the inside, the supporting substructure, and the force of the wave from the sea must have overturned 125 metres of the completed wall; caissons 46 and 47 formed monoliths with their superstructure ; caissons 48, 49 and 50 were more or less completely upset, all of them at least 45°. It is worthy of remark that caissons 51 and 52, with their superstructure not yet done, did not budge; and, of course, the caissons out to 46, which were fully buttressed inside, did not suffer at all.

The upsetting of this mass caused an enormous wave inside which came against caissons 48, 49 and 50 of the quay wall, which is placed concentric with and 74 metres from the sea wall, and spread out all over them without producing any marked canting.

The consequences following the Bizerta and Zeebrugge accident are very different.

I am absolutely of Mr. De Joly's opinion that the Bizerta breakwater was not thick enough, and I recall that at Zeebrugge, in seas not so bad, the thickness of the unsupported breakwater was set at 9 metres, as far back as 1892.

The thickness of 7.50 m. is amply sufficient for the buttressed portion, but the construction here requires a few special arrangements which the experience of several years had not pointed out, but which the accident of December 31, 1904, made clear.

Altogether, there was at Zeebrugge an accident of construction which causes no uneasiness as to the stability of the work when finished, and which will have been simply an object lesson causing a delay of a few months and also a small break in the unforeseen chances of the undertaking.

The President. — Gentlemen, after the very interesting discussion which has taken place,we must come to an agreement as to the conclusions to be adopted.

First of all I ask the Meeting whether, in spite of the very great diversity of conditions in which breakwaters outside of sea ports may be placed, it thinks that conclusions can, all the same, be formulated.

Mr. De Angulo Carlos. — I think that if conclusions could be formulated, they should be wholly general.

Mr. Nyssens-Hart. — I think that it would be very difficult to agree on conclusions, by reason not only of the diversity of local conditions referred to by the President, but somewhat also by reason of the diversity of systems applied in different countries.

Mr. De Joly. — He thinks that the Section should limit itself to stating that it has considered the reports presented to the Congress and the resulting information for the construction of breakwaters.

He proposes in the names of Messrs. De Thierry, Nyssens-Hart, Coen-Cagli and himself the following resolution which is adopted unanimously.

« The Congress refers to the information furnished by the » written reports and oral observations ; it considers that engi- » neers will find there information of great value for the

» construction of breakwaters, taking the force of waves into » consideration, but, by reason of the great diversity of cases, » it does not think that it should formulate any absolute » conclusions. »

These conclusions are read in German.

The PRESIDENT asks if any one else desires to be heard. As there is no reply, he asks the Meeting to raise hands in recognition of the fact that the work of the second Section of the Xth Navigation Congress is finished.

Most of the members raise their hands.

The PRESIDENT. — Gentlemen and dear colleagues,

I regret deeply that, for sundry necessities, the term of the Xth Navigation Congress should have been so short and that to-day witnesses the last of our meetings.

But, before leaving you, let me make a wish : I wish that it may possible for all the members here present to take part in the next Congress, whatever be the country in which we shall have the pleasure of seeing each other again, and that our discussions may he inspired with the same zeal and the same calmness which have been shown in this hall.

I wish also that, for a long time to come, we may be able to devote ourselves to the study of those questions of navigation whose solution must contribute in the highest degree to the advance of civilization and to the well-being of the nations.

(Loud applause.)

Mr. VERNON-HARCOURT. — Gentlemen, before we adjourn, allow me to offer, in your name and my own, all our thanks to our illustrious President who has so ably directed the discussions of this Section.

(Loud applause.)

The PRESIDENT thanks the Members of the Congress and adjourns the session at noon.

MINUTES

of the Concluding General Meeting

Minutes of the Concluding General Meeting which took place on Friday, September 29, at 2 p. m. at the Scala.

Mr. Colombo, one of the general presidents of the Congress, takes the Chair. The following are also present at the board table : His Excellency Mr. Pozzi, Under-Secretary of State for Public Works and one of the presidents of the Commission of Patronage, representing the Italian Government, Mr. Della Porta, representing the Syndic of Milan, Mr. Alphonse Debeil, directeur général des Ponts et Chaussées of Belgium and one of the presidents of the International Association, Dr. Ludwig Halle, under-secretary of State of the Prussian Ministry of Public Works, Baron Quinette de Rochemont, inspecteur général des Ponts et Chaussées of France, Mr. Charles Raymond, brigadier-general of the United States army, Mr. de Timonoff, directeur des voies de communication of Russia, Mr. Anton Schromm, inspecteur general of Austria, Mr. Van der Slyden, former minister of Waterstaat of the Netherlands ; Mr. Italo Maganzino, inspecteur supérieur du génie civil of Italy and departmental president of the Consultative Board of Public Works and Mr. Jean Ricotti, naval captain, both presidents of the local technical committee ; Messrs. Alberto Torri and Guiseppe Rota, italian delegates of the Permanent International Commission of the Association ; Mr. Romanin Jacur, deputy ; Mr. Ignazio Inglese, inspecteur supérieur du Génie civil, and Mr. François Guiliani, captain in the royal navy both presidents of Sections of the Congress ; Mr. Piero Pialo Daverio, president of the Executive Commission.

The seats of the general secretaries are occupied by Mr. Sanjust de Teulada, general secretary of the Congress, Mr. Alexis Dufourny, general secretary of the Permanent International Association, Mr. Leo Sympher, former general secretary of the Dusseldorf Congress, and Mr. Georges de Joly, representing France, Mr. Sanford representing the United States, Prince Itchito representing Japan and Mr. Richard Kuln representing Austria.

The delegates of foreign Governements and the Senators and deputies of the Kingdom of Italy occupy the same places as during the general inaugural meeting.

The hall is well filled and many ladies are observed to occupy the boxes.

The meeting is opened at 2.19 p.m.

The president declares the concluding meeting to be open and that the presidents and reporters of the various sections will submit to the meeting the conclusions the sectional meetings have arrived at.

The PRESIDENT. — In the first place I will ask Mr. Maurice Levy to convey to the meeting the conclusions which have been adopted by Section I. on Question I.

Mr. LEVY. — We are now considering the first question in the first section : —

On the advantages and organisation of mixed transports that is by railways and waterways.

Five reports were sent in on this subject. Each reporter has stated the reasons for his conclusions. The general reporter has summarized the principal conclusion of Messrs. Captier and Tavernier which was adopted in the following terms : —

« Connection between railways and navigable waterways » should be increased as far as possible, by technical, admi- » nistrative and fiscal means, with a view to develope to an » increasing extent mixed transport services. »

The president reads this conclusion aloud and puts it to the meeting. He requests those members who are in favour of the motion to signify their assent by raising their hand.

The conclusion is approved.

The PRESIDENT. — I will now ask Mr. Crugnola to submit the conclusions which have been adopted by the section on question III of Section I.

Mr. CRUGOLA. — The third question of the first section treats of the « *investigation of the methods best suited for surmounting great differences of level between the reaches of canals* ». This question was originally on the agenda of the Xth Congress held at Dusseldorf but at that time we were on the eve of the great international competition of Vienna which appeared likely to solve the problem definitely. For this reason the resolutions of that Congress were but tentative.

This competition has since taken place and if its result cannot be said to have solved the problem definitely, the designs sent in, taken as a whole, give very interesting information which bears upon special points arising from the main question.

The problem was therefore ripe for solution, and the numerous reports which have been submitted on the subject to this Congress have dealt with all the features of the question in an exhaustive effective manner.

One will easily understand that with such a wealth of information available and so many energetic reporters, the discussion could not fail to be commensurate with the importance of the subject under consideration.

The discussion has been both strenuous and well considered. The following distinguished themselves particularly in the discussion ; Messrs. De Bovet, Prüssmann, Gerdau, Genard, Van Panhuys, Smrcek, Vernon-Harcourt, Maurice Lévy, Schönbach, Schromm, Hermann, Guerreiro, Nelemans and others.

The solutions were almost unanimous, the first being identical with the one passed at the IXth Congress, and the others being the consummation of the wish expressed at that Congress, so that they may now be considered as definitive.

I will now read them out so that the Meeting may consider them before they are put to the vote.

« Locks with a chamber are the least complicated and most durable means of surmounting differences of level in canals. Side ponds enable a considerable amount of water to be economised without unduly increasing the time of locking.

Investigation and experiment should be encouraged with a view to reducing to a further extent the consumption of water and time of locking.

In cases where the water supply is inadequate, vertical lifts which are sanctioned by practical experience, can be adopted.

The Vienna competition led to a large number of very interesting projects. The Congress attaches the greatest importance to the application on a large scale of these schemes so that practical experience, which after all is the ultimate test of value, may enable one to gauge their comparative practical value, and the effect upon the speed of the boats, the traffic capacity of the canals, and the safety, regularity and economy of the service. »

The president puts the above conclusion to the vote in French and German. The English members do not insist upon an English translation. The conclusion is approved.

The PRESIDENT. — I now ask Mr. Valentini, first secretary of Section I, to read out the conclusions of Question II.

Mr. VALENTINI. — The second question of the first section is as follows : —

Influence of deforestation and of the drying up of marshes on the sphere of influence and on the performance of the rivers.

The Section submits the following conclusion : —

The drainage of marshes has generally little or no effect upon the conditions of flow and level of rivers. Deforestation, from a navigation point of view, suggests the following desiderata : —

1. Governments should enact lucid and severe laws to govern the maintenance of existing forests, the consolidation of mountainous forest lands and the afforestation of denuded lands, so as to avoid the damage occasioned to navigable waterways by the transport of material.

2. Hydrological investigations necessary to determine the influence of forests on the flow and level of navigable waterways, should be extended on a systematic basis and their results should receive the widest publicity.

The president puts the above conclusions, in French and German, to the vote. They are approved.

The PRESIDENT. — Mr. Valentini will now be good enough to read out the conclusions arrived at on Question IV.

Mr. VALENTINI. — The fourth question is as follows : —

Development of inland navigation by means of shallow draught vessels. — Mode of construction of these, and their motor.

The section adopts the conclusion which I will now read aloud : —

« The Congress, in view of the remarkable works published by the Association on the shape and haulage of vessels on inland navigable waterways and the primary importance of the question pertaining to this, expresses the wish that the Congress should place upon its agenda a question dealing primarily with the mechanical traction of vessels and secondarily with the investigation of the shape and utilisation of shallow draught craft. »

This conclusion is put to the vote in French and German and approved.

The PRESIDENT. — We will now pass on to the questions in Section II (Ocean navigation) and I will ask Mr. Inglese to read aloud the conclusions on question I of Section II.

Mr. INGLESE. — The first question was couched in the following terms :

Improvement of the mouths of rivers discharging into tideless seas.

The section, after entrusting a special committee with the drafting of conclusions, voted the following conclusions on the recommendation of the aforesaid committee : —

« The system of mole construction is advisable so long as the distance between the bar and the foreshore does not entail undue expense. Where this expense is likely to be heavy and especially in the case of deltas which have been well consoli-

dated after many years, the system of dredging — especially by means of suction-dredgers — is an excellent solution of the problem, on condition however that the expense entailed by these dredgers is justified by the traffic.

» In some instances, dredging accelerates or completes the action of jetties.

» Where neither of the above systems are suitable, the system of lateral canals with the mouth situated outside the sphere of action of the delta, is a simple and sure solution of the problem.»

The President. — I will read in French the first conclusion on this question *(he reads)*.

Mr. Germelmann will read it in German.

Mr. Germelmann reads in German the summary of the discussion. *(The president rings the bell.)*

The President. — I beg to remind you, Mr. Germelmann,that we may only vote on the conclusions of the various sections, whereas you are now reading a summary of the whole discussion. It appears to me that members of the Congress should be satisfied with the mere translation of the French text, so that we may not unduly prolong the meeting.

I will ask those of you, Gentlemen, who agree to the conclusion, to signify the same by raising your hands.

The conclusion is accepted.

(Mr. Germelmann protests.)

The President. — I very much regret to have to interrupt you, but if we were to listen to the summary of each discussion we should never finish. The terms in which you present your conclusions in German are too vague.

Mr. Holle. — The conclusions are subject to discussion. The members of the Congress should at least say whether they desire that these conclusions should be read in the German language. This will be easily done if one of the German members will kindly read or translate the French text into German. I should regret exceedingly if the German language were thus excluded.

The PRESIDENT. — I beg to point out to members of the Congress that conclusions to be voted upon should be drawn up in a precise form. For this reason I cannot allow conclusions to be voted in a summarized form in one language and at the same time *in extenso* in another language.

(Prolonged applause).

The general secretary requests Messrs. Muller and Rosen, translators of the secretarial department, to ascend the platform. Mr. Rosen reads the conclusions of the first question in German which is adopted unanimously (1).

The PRESIDENT. — Let us now take the second question which is : —

Progress in methods of propulsion of vessels. Effect of these on channels and harbours.

The conclusion adopted by the section is as follows : —

« In the actual state of the science, the progress accomplished in the means of propulsion for ships does not affect the designs of channels and harbours. »

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(1) In fact the section had already voted according to the following report submitted by a Committee. The vote at the general meeting is only an abridged from drafted by the secretaries. The report referred to is as follows :

« The great diversity of local technical conditions and also the economic and financial conditions which cannot be overlooked by engineers does not admit at present of any general and absolute laws to be formulated for improving the condition of river mouths opening into tideless seas or seas which have only a slight tidal rise and fall. Each case may have its own special solution and no general formula can be arrived at before an extensive enquiry has been carried out bearing not only on présent conditions but also on the variable conditions of the past.

» This being granted, experience has proved that a solution could, according to the circumstances of each case, be found either by immovable structures, especially by jetties, or by dredging, or else by a combination of these two methods.

» As regards jetties, the Congress of 1892, has placed on record certain views, which are still of value, concerning the natural conditions which are essential to the success of this system. The Congress of 1892 has also given certain advice, to which members are referred, regarding the selection of the particular branch to be improved in the case of a delta.

» We may add, as indicated in the reports submitted to the present Congress:

» 1. The width and volume of flow of the selected branch should generally be reduced to a minimum consistent with the requirements of navigation, so as to

The translators render this into German. The English members waive the English translation. Every one approves

The PRESIDENT. — The third question reads as follows : —

Review of the various methods of working and administration of seaports. — Their influence on the developement of trade.

Here is the conclusion which has been adopted by the section : —

« Any system of administration which increases the prosperity of the port and developes its trade, is good, provided it is properly carried out ».

The terms in which this conclusion is couched occasions some laughter. After reading this conclusion in French it is rendered into German and approved.

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allow the greater portion of the waters as well as of the solid matter held in suspension to flow through the other branches of the delta.

» 2. The works must be designed so as to facilitate any extension which may eventually be necessary in the more or less remote future.

» 3. In order to achieve success, it is desirable especially when there is a bar, to build the jetties as rapidly as possible and to make them sufficiently long to extend at least to dredgeable depths.

» As to dredging, the immense improvements in this system during recent years the construction and working of dredging machinery and the introduction of suction-dredgers, have increased the capacity and efficiency to such an extent that the Congress of 1900 justly called the attention of engineers to it.

» Even in the case where success depends chiefly upon fixed structures, dredging operations will frequently become necessary for acceleration, completion, maintenance and deepening. Dredging alone will frequently suffice, either in the case of a long delta which has been consolidated by the action of time, on in crossing a bar situated at such distance from the foreshore that jetty construction is not praticable on condition, however, that the advantages gained by dredging are maintained by the erection of fixed subsidiary works for regulating the distribution of the waters at the outlet of the delta or for protecting the dredged channel against lateral pressure. In this case these subsidiary works should consist of jetties built as low as possible and quite simple in design.

» In short dredging is a powerful and simple weapon in the hands of engineers, applicable in most cases which have to be dealt with and frequently preferable, but nevertheless a means which cannot be considered of absolute efficacity without limits. It occasionally entails, when nature is opposed, considerable permanent sacrifices which can only be justified by the importance of the traffic. There are even cases where the bottom is liable to shift to such an extent under the

The PRESIDENT opens the discussion on the fourth question which runs as follows : —

Construction of the outer moles of ports, having regard to the force of the waves which they have to resist. — Estimation of this force.

The conclusions are submitted in French and in German in the following terms : —

« I. It has hitherto been impossible to measure accurately the force of the waves and the blows with which the break upon the outer moles.

» The destruction of works at sea is due to repeated blows, which it has hitherto been impossible to measure.

» When designing new works at sea, engineers will find most valuable data in existing works which should be considered with respect to conditions of the wave action out at sea, the contour of the foreshore, the shape of the sea-bed at the approaches of the port and all other circumstances which may affect judgment.

» II. The Congresse refers enquirers to the information which has been furnished in the written reports and as well as in the oral remarks. It is of opinion that engineers will there find valuable data for the construction of moles with respect to the

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action of the sea that this method of dealing with the problem is not to be thought of for one moment.

» When for technical or financial reasons the methods which have been described are inadequate, the construction of a tributary canal with an outlet into the sea beyond the sphere of action of the mouth will have to be considered.

» It will be necessary in any case, before undertaking important works at the mouth of a river, to examine this solution from a comparative point of view since it is a simple and reliable solution when local conditions are favourable.

» *Signed* :

» PAOLO ORLANDO,
» L. F. VERNON HARCOURT, President,
» MENGIN-LECREULX,
» DE TIMONOFF,
» G. TURAZZA,
» L. LUIGGI,
» L. CORTHELL,
» GERMELMANN,
» NYSSENS-HART. »

force of the waves, but it does see its way, in view of the great diversity of cases, to formulate any absolute conclusions on the subject. »

These conclusions are approved.

The president thereupon declares the discussion to be closed.

The president then calls upon the following speakers whose remarks are reproduced in the language in which they were uttered.

Address by Mr. Alphonse Debeil, president of the Permanent International Association of Navigation Congresses, directeur général des ponts et chaussées : —

Messieurs les Président et Membres de la Commission d'organisation du X^e Congrès, Mesdames et Messieurs.

Il y a quelques jours à peine, au moment où les Souverains de l'Italie venaient inaugurer nos travaux dans une séance d'ouverture qui restera mémorable dans nos annales, au moment où, par leur présence auguste, Ils daignaient accorder une nouvelle consécration, dont nous leur sommes profondément reconnaissants, à notre garnde Association, j'expremais au nom de celle-ci, en ma qualité de Président, l'espoir de voir le X^e Congrès couronné de succès.

Notre attente à tous, c'est un devoir pour moi de le déclarer, a été largement dépassée. Le travail que vous avez accompli, sous la Haute Présidence de nos très honorés et très chers Présidents Généraux, MM. les Sénateurs Colombo et Candiani, et sous la direction immédiate de vos éminents Présidents de Section MM. les Ingénieurs Casana, Romanin Jacur, Inglese et Giuliani, ce travail, dis-je, a été considérable et réellement fructueux ; on vient de vous en rendre compte, et je n'ai plus dès lors que des éloges et des remercîments à adresser. J'ai aussi le devoir de vous proposer des remercîments et des éloges pour la Commission d'organisation tout entière, pour son infatigable et distingué Secrétaire Général, M. Sanjust di Teulada, pour ses dévoués et sympathiques Présidents, MM. Maganzini, Ricotti et Piola Daverio.

Nous avons été reçus à Milan et dans toutes nos excursions, avec un éclat, un entrain, une cordialité que nous ne saurions

assez reconnaître, et pour lesquels nous ne saurions avoir assez de remercîments. Nous prions la Municipalité de Milan qui a tant fait pour nous, qui nous a prodigué tant d'attention et d'amabilité, de croire que nous conserverons pour elle dans nos souvenirs la plus vive reconnaissance. C'est également un devoir pour nous et un extrême plaisir de remercier les puissantes Compagnies des Usines électriques de Paderno, de Vizzola, comme aussi M. le Comte Borromée dont la réception dans son admirable domaine a été d'un charme exquis, de toutes les peines et sujétions que la présence de notre nombreuse armée a pu leur occasionner. Partout, nous ont précédé l'accueil le plus obligeant, la prévenance la plus attentive ; notre Association en est profondément touchée et reconnaissante, et je suis certain d'être son fidèle interprète en vous adressant une fois encore l'expression de toute notre gratitude et de tout notre dévouement. (Applause.)

Président Colombo. — Mesdames ,Messieurs, à propos des admirables paroles prononcées par M. Debeil à l'égard de M. le Syndic et de la Municipalité de Milan, je puis lui affirmer que M. le Syndic a regretté très vivement de ne pas avoir pu être présent à cette séance ; mais il attend MM. les Congressistes au Castello Sforzesco pour les recevoir au nom de la ville, et il y remerciera spécialement M. Debeil des belles paroles qu'il a prononcées.

Addres of His Excellency Anton Schromm, Hofrat. KK. Binnenschiffahrts Inspector, representing Austria : —

Es wurde mir die angenehme Aufgabe zuteil, namens der oesterreichischen Regierung und aller Landsleute, die hierher zu kommen Gelegenheit hatten, den besten und innigsten Dank auszusprechen für den liebenswürdigen und herzlichen Empfang, den wir hier in Mailand getroffen haben.

Signore, Signori, Mesdames, Messieurs, j'ai l'honneur de remercier au nom du gouvernement autrichien et au nom de tous les délégués qui ont eu l'honneur d'assister aux conférences de ce congrès, le gouvernement italien et l'honorable présidence pour l'accueil reçu ici à Milan. Nous espérons que les résolutions sanctionnées il y a quelques minutes par le vote à main

levée, se réaliseront autant que possible. Ceci doit être le désir de tous les vrais amis de la navigation, soit maritime soit intérieure. (Applause.)

Address of Baron Quinette de Rochemont, Inspecteur général des Ponts et Chaussées, representing the French Republic : —

Mesdames, *Messieurs*,

Permettez-moi, avant de prendre la parole au nom de la Délégation française, de vous exprimer combien je suis fier du grand honneur qui m'a été fait en me désignant pour votre interprète dans la Séance Royale d'ouverture.

Cet honneur marquera le point culminant d'une carrière longue de près d'un demi-siècle, et tout entière consacrée à la Navigation.

Excellences, *Mesdames*, *Messieurs*,

Ce serait m'imposer et abuser de votre bienveillance à mon égard que de prononcer encore un discours, alors même que je le ferais au nom de mon pays.

Je ne pourrais, d'ailleurs, que répéter ce que d'autres orateurs et moi-même avons déjà dit dans ce Congrès.

Aussi me bornerai-je, au nom de la Délégation du Gouvernement français et à celui de tous nos compatriotes, à vous assurer de notre reconnaissance pour la grandeur, la beauté et surtout la cordialité de la réception qui nous a été faite et à constater le succès sans précédent du X^{e} Congrès.

Nos remerciements s'appliquent spécialement à la Commission d'organisation, à la Ville de Milan et au Gouvernement italien qui a largement contribué à ce succès.

Sa Majesté le Roi et Sa Gracieuse Majesté la Reine qui ont tant fait pour le rapprochement de l'Italie et de la France ont tout particulièrement droit à notre gratitude pour avoir daigné présider à l'ouverture du X^{e} Congrès de Navigation. (Applause.)

Address of D^{r} Holle, Königlich Preussicher Unterstaatssekretär in Ministerium der öffentlichen Arbeiten in Berlin, representating Germany :

« In Namen der Delegierten des Deutschen Reiches und der zahlreichen deutschen Kongressmitglieder habe ich die Ehre,der

Königlichen Regierung Dank zu sagen für die Einladung und den prächtigen Empfang, sowie der Stadt Mailand für die Gastfreundschaft, die wir während des Kongresses in ihren Mauern genossen haben und noch geniessen werden. Wir haben ferner zu danken dem geehrten Präsidenten Herrn Colombo, dem ich soeben einen kleinen Zwischenfall verursacht habe, was ich bedauere,für die bereitwillige Uebernahme der Mühen und Arbeiten, die die Vorbereitung eines so zahlreich besuchten und bedeutungsvollen Kongresses erfordert haben und für die geschickte Leitung der geschäftlichen und geselligen Angelegenheiten. Schliesslich aber nicht zum mindesten danken wir den Mitgliedern des ständigen Bureaus dieser Kongresse, deren unermüdlicher Fleiss und Eifer den Kongress in bester Weise vorbereitet und dazu geführt hat, dass nicht weniger als 354 Drucksachen ausgeteilt wurden, ein Beweis ihrer enormen Schaffenskraft.

» Meine Damen, meine Herren : Bereits bei der Eröffnung des Kongresses war zu vernehmen, dass in Deutschland die staatlichen und kommunalen Behörden auf allen Gebieten der See- und Binnenschiffahrt wetteifern und demgemäss in Deutschland grosse und schwierige Aufgaben der Wasserwirtschaft gestellt sind. Auf diesem Kongresse haben sich Männer aller Nationen, Autoritäten der Wissenschaft und der Praxis vereinigt, um die Wege und Ziele zur Lösung dieser Aufgabe zu vervolkommen, und die Zielpunkte der wasserwirtschaftlichen Entwickelung festzulegen.

Wir scheiden von dem X. Internationalen Schiffahrtskongresse von Mailand in dem hohen Bewusstsein, dass es gelungen ist, weitere Bausteine zu legen zur Förderung der Schiffahrt,zur Hebung des Wohlstandes aller Völker und zum Segen unseres Deutschen Vaterlands. » (Applause.)

Address of Mr. Francis Leveson Vernon-Harcourt, civil Engineer, representating Great-Britain and the Institution of Civil Engineers of London :

Excellence, Messieurs les présidents, Mesdames, Messieurs,

Je suis fier d'être l'interprète de la Grande-Bretagne, puisque l'Italie et la Grande-Bretagne, depuis bien longtemps, ont eu les relations les plus amicales, et j'espère que ces deux nations

qui ont été si unies par des liens d'amitié le seront encore davantage après le Congrès de Milan. Aussi ne dois-je pas oublier que je suis ingénieur des ports de mer, et délégué de l'Institut des Ingénieurs Civils de Londres. Depuis le Congrès de la Haye en 1894 les Congrès de Navigation s'occupent des travaux maritimes, aussi bien que de la navigation intérieure ; par conséquent ils présentent à présent le plus grand intérêt pour l'Italie et la Grande-Bretagne, qui, parmi les grandes puissances de l'Europe, ont les côtes les plus étendues, et les ports maritimes les plus nombreux ; et c'est précisément à ces deux nations que s'applique le mieux la devise des Congrès de Navigation « Navigare necesse ».

Je crois devoir remercier bien vivement la Commission d'organisation et son président, qui me rappelle par son nom le célèbre explorateur Christophe Colomb (laud applause) ; je ne dois pas oublier aussi le Secrétaire général bien dévoué M. le Baron Sanjust de Teulada. Nous allons quitter maintenant cette charmante Cité de Milan, où nous avons rencontré un si chaleureux accueil, pour aller visiter les villes de Gênes, Spezia, Naples et Venise, où nous attendent de même des réceptions très hospitalières. Je désire terminer par ces vœux très sincères et qui sortent du cœur :

Viva l'Italia, viva il Re d'Italia, viva la Regina d'Italia, viva il Congresso di Navigazione. (Applause.)

Address of His Excellency Van der Sleyden, former Minister of Waterstaat, representating the Netherlands :

Mesdames, Messieurs, Permettez-moi de témoigner au nom du gouvernement des Pays-Bas au gouvernement italien, à la Municipalité de Milan, et principalement au président et à tous les membres des différents Comités, tous mes remerciements pour la réception enthousiaste qui nous a été faite, et de terminer mes paroles en émettant le vœu le plus sincère pour la prospérité de l'Industrie et du Commerce italiens ». (Applause.)

Address of His Excellency M. de Ghercevanoff, member of Council of the Ministry of Ways and Communication, representing Russia :

Mesdames, Messieurs, je ne me crois pas en droit de profiter de l'honneur et du plaisir d'exprimer tous mes remerciements de

reconnaissance aux représentants de l'Italie qui nous ont fait un si chaleureux accueil et de remercier les représentants de l'étranger pour leur travail si intelligent, et je passe la parole à M. de Timonoff, qui va la prendre dans votre langue chérie, qui n'a pas encore été parlée aujourd'hui dans cette séance, la langue italienne.

Address of Mr. de Timonoff, Director of Ways and Communications, St-Petersburg district :

« Egregi Signori e Signore. Compreso dell'importanza del momento storico in cui si raduna il X^{e} Congresso internazionale di Navigazione, unisco anche a nome dei delegati del governo russo la mia voce a quelle che già a più riprese e in termini eloquenti hanno anunciato l'era nuova che si apre ai popoli in seguito al comune lavoro civilizzatore delle sedute scientifiche internazionali. I delegati russi credono realmente all'utilità dei nostri Congressi, non soltanto per promuovere studi di recerche scientifiche e perchè pongono in comune il frutto delle esperienze di tutti, ma anche perchè riuniscono gente di tante nazioni, lo che è il mezzo più efficace per rimuovere pregiudizi, dissipare malintesi, stimolare le relazioni internazionali e stringere spontanee e cordiali amicizie (Applause) le quali non possono non contribuire ad affrettare il giorno in cui si porrà fine alle guerre (Applause). Pieno di questa fede spero di non essere autorizzato dalle circostanze attuali a sviluppare maggiormente questo tema. Cercherò quindi di rimanere nelle strette limiti dell'opera dei Congressi di navigazione. La Russia è paese in cui le vie navigabili interne hanno un'importanza grandissima. Per darne un'idea basti dire che l'estensione della rete dei canali e dei fiumi per la Russia deve raggiungere 130,000 chilometri, che il tonnellaggio totale annuo passa i 300 milioni, che sul Volga navigano più di 2000 bastimenti a vapore. E questa grande rete è in continuo stato di perfezionamento che tende a dare maggiore omogeneità e capacità di trasporti.Fra i lavori più importanti eseguiti ultimamente a tale scopo conviene notare in primo luogo il miglioramento del sistema dei canali Neva-Volga con cui si unisce il Mar Caspio al Baltico, della lunghezza complessiva di 4000 chilometri, il che permette di trasportare direttamente e senza trasbordi il petrolio da Baku a Pietroburgo. Poi vengono i lavori del Volga

stesso che meritano tutta l'attenzione degli ingegneri, l'escavazione meccanica avendo completamente sostituito la costosa canalizzazione. Senza permettermi di trattenere di più la loro attenzione sui lavori della navigazione interna nominerò di passagio l'apertura recentissima del lago di Ladoga alla navigazione marittima, il che ha aggiunto al Mar Baltico una linea costiera di mille chilometri. Nel dominio dei porti il progresso è pure assai grande. Lo sviluppo sempre crescente delle relazioni commerciali della Russia con l'estero e sopratutto quello rapidissimo dei porti del Mar Nero, alleati naturali dei porti italiani, ha preso uno slancio cosî considerevole che ha provocato la creazione di un ministero speciale incaricato di tale servizio. La direzione generale della navigazione marittima e dei porti ha esteso un programma generale per i lavori da eseguirsi nei porti per aumentarne il numero, la capacità e la profondità, e dotarli di macchinismi moderni. Tale programma è già in via di realizzazione. Fra gli ultimi lavori di grande importanza devo citare anche quelli dei porti di Libau, Pietroburgo ed Odessa, e specialmente quelli dell'apertura della foce del Dnieper alla navigazione marittima. Si stanno anche studiando i mezzi per aumentare la forza della nostra flotta commerciale e i provvedimenti presi hanno già dato buonissimi risultati. Loro,signori, vedono dunque di quale importanza sia per la Russia il vasto dominio delle scienze idrauliche e delle sue applicazioni che i Congressi di Navigazione si sono appropriati. È chiaro che la Russia ha un interesse speciale di seguire davvicino i lavori di questi Congressi nei diversi paesi del mondo che li ospita. Possono immaginare quanto siamo felici che il X° Congresso si raduni in Italia che ci attira sempre non soltanto per la bellezza della natura e per lo splendore dell'arte, ma anche per l'ammirabile attività spiegata dagli ingegneri italiani in tutti i rami dell'industria e dei trasporti. I lavori del Congresso di Navigazione sono terminati, e benchè l'ora della separazione non abbia ancora suonato, è prossima. Per quanto coraggiosi siamo non possiamo a meno di sentire una stretta dolorosa al cuore al pensiero della parola che pur troppo dobbiamo pronunciare. Questa parola dal suono triste come quella di una corda che si spezza è la parola « Addio », che noi stranieri dobbiamo rivolgere a voi fortunati abitanti dell'Italia, a voi e al vostro bel paese. I giorni trascorsi qui non furono molti ma sono stati tanto pieni di sensazioni incantevoli a di impressioni profonde che non si

scordano mai. Nè il passato importantissimo dei nostri Congressi nè l'avvenire che sta loro dinanzi potranno mai cancellare dalla mente e dal cuore dei membri esteri del X° Congresso l'accoglienza piena di cordialità e di gentilezza che gli Italiani ci hanno fatto. Un « grazie » profondamente sentito a tutti quelli che hanno contribuito al successo del Congresso in Italia e a renderci delizioso il soggiorno in questo paese così ospitaliero. A nome del governo russo e dei suoi delegati noi ci inchiniamo col più profondo rispetto e la maggiore riconoscenza verso S. M. il Re d'Italia il quale non solo ha concesso al Congresso il suo alto patronato ma si è degnato di assistere alla seduta di inaugurazione. Siamo poi pieni di ammirazione e riconoscenza per S. M. la gentile Regina che ha voluto onorare con la sua presenza la prima seduta del Congresso. Noi porgiamo i più sinceri ringraziamenti a S. A. R. il Duca di Genova che ha gentilmente accettato la presidenza d'onore, alle loro Ecc. i ministri della Marina e dei LL. PP., alle Commissione di organizzazione, alle diverse amministrazioni, e alla stampa italiana che ha dedicato ai lavori del Congresso la più grande attenzione. In ultimo io ringrazio l'intelligente pubblico milanese e specialmente le amabili signore che hanno voluto abbellire le nostre sedute con la loro preziosa presenza. Last but not least.

Addio, gentile città di Milano, anzi tutto incantevole pian di Lombardia ardentissimamente sospirato per tanti anni di malinconia. Allontanandoci da voi diremo con tristezza col vostro poeta :

A viva forza di colà mi svolsi
Dove gotico tempio alza giganti
I trionfali culmini eccelsi.

Evviva l'Italia. (Laud applause.)

Address of Mr. Valdès, Engineer of the port of Barcelona, representing Spain :

Mesdames, Messieurs, vu l'absence obligée de notre illustre président, l'inspecteur général Señor Lopez-Navarra, je prends la parole au nom de la délégation espagnole, pour remercier chaleureusement, en premier lieu le président et le secrétaire général du Comité d'organisation, M. le Sénateur Colombo et M. Sanjust de Teulada, pour l'aimable attention dans tous les

détails d'organisation et de préparation de ce Congrès. Je remercie Messieurs les présidents des sections de la navigation maritime et intérieure, les secrétaires en chef des mêmes sections pour la constante preuve de déférence qui s'est manifestée spécialement à l'occasion de l'émission des rapports, présentés tardivement.

En même temps il m'a été donné la mission de présenter un salut confraternel à tous les collègues présents, non di amico, ma di fratello, et non seulement à ceux de l'Italie, mais aussi des autres nations, qui n'ont pas craint de longs voyages pour pouvoir assister à un Congrès qui a comme but le plus pur idéal de l'humanité, poussé par l'amour de la Science, et par l'amour du travail. (Laud applause.)

Address of Major H.-F. Hodges, Engineer, U. S. Army, representing the United States of America :

« M. President, Ladies and Gentlemen, on behalf of the Government of the United States of America and of the delegates who have the honour to represent that government here, it is me pleasant duty to express appreciation of the manner in which the affairs of the Xth Congress of Navigation have been conducted, and thanks for the many kindnesses which have been shown to the delegated during their stage in this beautiful City.

» It is no light matter to organize and carry to a successful conclusion the complicated business of such a congress and those who are charged with that duty may well feel afraid at the magnitude of their task. To the President of the Congress, to the General Secretary and to their collegues of the Committee who have aided in the organization and affairs of the Congress, I render our thanks and compliments for the ability, inducted patience and courtesy which they have displayed and our congratulations for the great success which has attended their labours.

» Apart from the business of the Congress I desire also to offer our grateful acknowledgment of the many pleasures which we have enjoyed during our stage in Milan, and of the kindly hospitality which has been shown to us. We have come from a great distance to take part in this Congress and anticipated much profit from the discussions and conclusions ; what we did not anticipate was that combined with that profit there would be so

much pleasure ; but the welcome which we have received has been so cordial and the efforts for our entertainment have been so successful that the resolutions pleasure alone would have been ample. I offer on the part of my collegues as well as myself our warmest thanks to the gentlemen of the Municipality for the care with which they have made of the Congress such a source of pleasure, and I desire to express in conclusion the hope that the pleasant personal acquaintances which have been founded amony may not elapse with the conclusion of the Xth Congress.» (Applause.)

Address of Mr. de Gonda-Bela, Sektionsrat, Chef der See- und Flusschiffahrts, representing Hungary :

Mesdames, Messieurs, le X^{me} Congrès qui vient de se clore, termine la série des jours passés parmi vous, jours qui vivront toujours dans notre mémoire, comme témoignage de notre plus vive reconnaissance envers la noble Cité et le noble pays d'Italie, où nous fûmes accueillis avec tant de cordialité et de sympathie, et comblés de gentillesses et de soins. (Applause.)

Mr. Colombo, President of the Congress :

Messieurs.

Le 10^{me} Congrès international de navigation, inauguré il y a cinq jours par S. M. le Roi d'Italie, en présence de notre gracieuse Reine, et avec l'intervention des Ministres des Affaires Etrangères, des Travaux Publics et de l'Instruction, s'est réuni aujourd'hui pour sa dernière séance, pour la lecture de ses conclusions qui ont été votées à la grande majorité des congressistes présents.

Monsieur le Sous-Secrétaire d'Etat des Travaux publics nous a fait l'honneur d'assister à cette dernière réunion. Nous le prions d'accepter nos remercîments. Nous lui sommes reconnaissants avant tout comme Représentant du Gouvernement italien parce que c'est à l'initiative et à l'intérêt constant du Gouvernement que nous devons le succès du Congrès. (Applause.)

Nous le remercions aussi personnellement pour la vive sollicitude avec laquelle il a aidé la Commission d'organisation dans les travaux d'organisation du Congrès. (Applause.)

Je regrette que de hauts devoirs aient empêché notre Président d'honneur, Son Altesse Royale le Duc de Gênes, de prendre part à nos travaux. En votre nom, Messieurs, je lui envoie un salut respectueux ainsi qu'à Messieurs les Ministres des Travaux Publics et de la Marine, sous les auspices desquels le Congrès a été ouvert. (Applause.)

Avant de nous séparer, je sens le devoir de remercier publiquement, au nom aussi de mon collègue dans la présidence, M. l'Amiral Comte Candiani d'Olivola, nos vaillants collaborateurs dans la tâche difficile de préparer et d'organiser le Congrès. Il s'agissait d'abord de régler toutes les questions qui se rattachent à la présentation des mémoires et des communications pour le Congrès, et à l'ordre de leur discussion. Il s'agissait ensuite d'étudier et de faire marcher les mécanismes si délicats, qui sont nécessaires pour assurer le succès d'une réunion si nombreuse et si importante. Toutes ces difficultés ont été vaincues, grâce à l'énergie, à l'intelligence et à la bonne volonté de nos actifs et dévoués collaborateurs. La Commission d'organisation est bien heureuse d'avoir eu de tels collègues et d'avoir pu utiliser leur efficace concours.

Grâce aux dispositions qui ont été prises, le Congrès a pu se réunir, commencer et continuer ses discussions selon le programme prescrit, malgré l'affluence très grande des congressistes. Ils ont été en effet 1200 environ, appartenant à un grand nombre d'Etats, 37 desquels ont été représentés au Congrès.

Dans l'intervalle des discussions, nous avons organisé des excursions aux environs de Milan, qui, je crois, ont eu votre approbation. Les dernières excursions auront lieu après la clôture, et j'espère qu'elles auront le même résultat.

Je ne pourrais pas résumer ici les discussions qui ont eu lieu ; mais les conclusions si claires qui ont été lues donnent une idée parfaite des travaux du Congrès et des résultats des discussions. Ces conclusions que nous avons votées paraîtront peut-être à quelques-uns pas assez concluantes. Cette indétermination de conclusions n'est pas un défaut spécial de notre Congrès ; il arrive ordinairement que les conclusions des Congrès, même les plus importants, ont un caractère de grande, et peut être d'ex-

cessive généralité. Mais ce fait est dû à une circonstance qui justifie parfaitement la difficulté de pas arriver à des conclusions précises. Les questions de science appliquée n'admettent pas toujours des solutions exactes et bien déterminées, parce qu'il faut avoir égard dans tous les cas aux circonstances dans lesquelles les phénomènes examinés se produisent. Il en est autrement lorsqu'il s'agit de questions de sciences positives, dans lesquelles l'expérience ne joue aucun rôle, et il est facile de déterminer des vérités que l'on croit exactes et de les énoncer dans des propositions précises. Il faut dire pourtant que les avantages des Congrès ne consistent pas dans la possibilité de formuler toujours de conclusions déterminées, mais dans celle de faire connaître sous tous les aspects les questions qui ont été discutées dans les diverses séances. (Applause.). Et lorsque ces questions ont été étudiées sous tous les aspects, il est plus facile pour la pratique, éclairée par la discussion, d'arriver à choisir la solution qui, dans les circonstances où l'on se trouve, paraîtra la meilleure. (Applause.)

Les Congrès ont encore un grand avantage ; ils créent ce qu'en Italie nous appelons l'*ambiente*. Ils appellent vivement l'attention du public sur les questions posées et discutées dans leurs réunions.Je pourrai donner un exemple de cela pour notre réunion, car je crois pouvoir affirmer que le Congrès tenu à Milan en ces jours a rendu populaire en Italie, bien plus encore que toutes les études et tous les travaux précédents, la question de la Navigation intérieure. (Applause.)

Cette popularité est certainement une importante victoire pour tous ceux qui ont été les apôtres de la navigation intérieure en Italie, et elle servira à les confirmer dans leurs convictions et à rendre leur apostolat plus efficace.

Vous avez pu voir les résultats de leurs études ; ils résultent des dessins, des tableaux et des statistiques exposés dans les salles de la Villa Reale. Vous avez examiné la carte hydrographique italienne, due au Ministère de l'Agriculture et du Commerce. Vous avez vu le détail des études anciennes et récentes sur le cours du Pô et sur les corrections nécessaires pour assurer la navigation de cette grande rivière de Venise à Pavie et au delà et la mettre en communication avec les villes plus importantes de la haute Italie. Vous avez remarqué les projets parallèles et si intéressants pour établir par le Tibre une voie de communication entre la capitale du Royaume et la mer. Maintenant ces

plans, ces études et les discussions qui s'y rapportent ont infiltré dans les masses la conviction qu'il s'agit d'un grand intérêt national et qu'il faut approfondir davantage ces problèmes et hâter leur solution pour compléter le réseau des communications d'un bout à l'autre de la péninsule, et contribuer par cela au progrès économique du pays.

Pour toutes ces raisons, nous, Italiens, devons être très reconnaissants aux promoteurs et aux collaborateurs de l'Association Internationale et du X^{e} Congrès de Navigation. Nous devons être reconnaissants d'abord à la Commission permanente de Bruxelles qui a tant contribué au succès de notre réunion, et nous devons la même reconnaissance aux savants qui ont adhéré à l'invitation de la Commission et se sont donné rendez-vous à Milan. Nous avons cherché à faire de notre mieux les honneurs de notre ville aux personnages illustres qui l'ont honorée de leur présence, et nous espérons, Messieurs les Congressistes, en quittant l'Italie, que vous porterez dans votre cœur un souvenir agréable des jours passés avec nous. (Applause.). Nous aurions le droit de l'espérer, après avoir entendu les paroles trop aimables que les représentants des nations étrangères ont bien voulu prononcer à notre adresse aujourd'hui ; nous l'espérons d'autant plus que l'Association Permanente de Bruxelles a voulu donner à notre pays une preuve de sa sympathie en nous offrant son concours pour la malheureuse Calabre, si durement éprouvée par le terrible cataclysme que l'a frappée. Nous remercions vivement l'Association et l'assurons que son acte généreux restera toujours imprimé dans nos cœurs. Veuillez donc me permettre d'exprimer, au nom de la Commission d'organisation, notre profonde reconnaissance et nos saluts respectueux aux Nations qui ont été représentées au Congrès et aux illustres personnages délégués pour les représenter. Messieurs, je suis sûr de votre consentement en vous demandant que notre dernière pensée, au moment de nous séparer, soit adressée à celui au nom duquel le Congrès a été inauguré, à celui au nom duquel M. le Sous-Secrétaire d'Etat va prononcer la clôture de nos travaux.

Sa Majesté le Roi d'Italie, convaincu de la haute signification du Congrès de Navigation, a montré son grand intérêt pour nos discussions, d'abord en acceptant le Patronage du Congrès, puis en mettant à notre disposition sa Villa Reale, et enfin en accueillant notre prière d'intervenir et d'honorer de Son auguste

présence la séance d'inauguration. (Applause) Envoyons lui l'hommage de notre respectueuse gratitude. Répétons ici en nous séparant l'acclamation qui l'a accueilli lorsqu'il est entré dans cette salle, à notre première séance. Faisons en sorte que dans son château de Raccogini lui arrive l'écho du cri si cher au cœur de tous les Italiens, que nos collègues ont appris à répéter avec nous, le cri de : Vive le Roi ! (Laud applause — Vive le Roi !).

Addres of His Excellency Pozzi, Under-secretary of State tor for Public Works, on behalf of the Italian Government :

Signori Congressisti, *Signore gentili*,

« I lavori del Congresso si sono svolti, e sono stati compiuti in modo egregio.

Furono intensi e proficui. E però degnamente corrispondono agli auspici lieti che dalla solenne inaugurazione di lunedì, onorata dallo intervento ambito e desideratissimo delle Loro Maestà gli Augusti Sovrani d'Italia, era lecito e doveroso il trarne.

Il Ministro dei LL. PP., trattenuto a Roma, ha lasciato a me il compito graditissimo di esprimere anche in nome suo, il compiacimento del Governo italiano, così per il concorso numeroso di Congressisti distintissimi stranieri ed italiani, come per l'opera attiva et fruttuosa del Congresso per il progresso della navigazione, e per le indagini scientifiche et pratiche che vi si rannodano. Ed io sciolgo il compito, anche con vivissimo compiacimento mio personale.

Di vero, il Governo italiano, il quale per tanti egregi funzionari suoi delle Amministrazioni Centrali, e del Genio Civile, e Marittimo, a presa parte notevole al Congresso, non poteva non prendere il più grande interessamento allo scioglimento che, e con le pregevolissime memorie presentate, e colla discussione nelle sedute, avrebbero ottenute le importantissime questioni che vi sono state proposte, attinenti alla navigazione interna ed alla navigazione marittima, attinenti alla navigazione interna ed la posizione e per la configurazione della Italia nostra, assumono importanza veramente somma e capitale.

Da questa importanza dei problemi proposti ai vostri studi ed alle vostre deliberazioni, scaturisce e deriva il corrispon-

dente sommo interessamento nostro alla soluzione sapiente che vi è stata data. Interessamento tanto più vivo et grande in quanto diretto al migliore apprezzamento di studii e proposte intese ad una finalità altamente provvida in ordine ai mezzi di trasporto, per la quale è profondo il convincimento del Governo di dovere adoperare totis viribus et toto cordè. Imperocchè i mezzi di trasporto facili, spediti et economici, non solamente servono ai bisogni esistenti, ma creano, suscitano bisogni sempre nuovi, quali essi valgono a soddisfare — e però determinano e portano il vero, il continuo progresso economico o sociale, fattore primissimo della civiltà. E per ciò che il Governo altamente si compiace della splendida riuscita di questo Congresso e che per mio mezzo assolve il debito gratissimo di esprimere a tutti colore che a questa splendida riuscita cooperarono, la sua riconoscenza viva, ed imperitura.

Il Presidente della Commissione internazionale permanente M. Alfonso Debeil, ed il Segretario General M. Alessio Dufourny, della personale amicizia dai quali grandemente mi onoro, hanno portato al Congresso tutto il contributo della loro alta intelligenza e della loro dottrina : ma non solo questo titolo essi vollero avere alla nostra riconoscenza, essi vollero aggiungervi un commovente attestato indimenticabile, di affetto amichevole e di solidarietà fraterna nella sventura colla generosa oblazione fatta à nome dell'Association Internationale permanente des Congrès de Navigation.

Vada adunque ad essi il nostro plauso più sentito, per l'una e per l'altra — mi è grato ripeterlo ancor io — di codeste grandi ed indimenticabili benemerenze. E plauso sincero e vivissimo vuole essere reso alla Presidenza del Congresso.

Il senatore Colombo ha voluto accennare cortesemente anche alla cooperazione personale mia : io so di non dovere questo se non alla sua indulgenza gentile ; ma non per questo gliene sono meno vivamente riconoscente.

I signori Presidenti del Congressa, i Presidenti delle Commissioni tecniche, i Presidenti delle Sezioni, i Relatori generali, gli autori delle Memorie, dei quali non ripeto tutti i nomi, a tutti voi meritamente noti, pur non potendo dimenticare per l'Italia quelli dei senatori Colombo, Candiani e Sasana, dell'onorevole Romanin Jacur, del commendatore Maganzini, Inglese, Giuliani, Torri, Rota, Mazza, Sassi, Crugnola, Lo Gatto, Valentini, Coen Cagli, ed il Segretario generale Sanjust di Teulada

insuperabile per intelligenza e zelo ; e quelli dei vari delegati esteri, vogliano tutti accettare le espressioni di vera e vivissima riconoscenza per l'opera preziosa che alla buona riuscita del Congresso essi hanno prestata, coadiuvati mirabilmente da tutta la Commissione di Amministrazione, presieduta dall' on. ing. Piola Daverio, la quale ha saputo compiere un lavoro di organizzazione veramente meraviglioso.

Il Comune di Milano fu anche in questa, come sempre ed in ogni occasione, l'ospite cortese e cordiale non superabile, e la sua Egregia Rappresentanza, cotanto degnamente presieduta dall' illustre senatore Ponti, ha nel miglior modo confermato la bontà della designazione lusinghiera e gentile della Città di Milano a sede del X° Congresso.

Le escursioni che i sigg. Congressisti hanno fatte furono interessantissime, e veramente riuscite. Faccio augurio caldo — nè punto ne dubito — che interessanti e felici non meno abbiano ad essere quelle che ancora vi attendono. E che il bel sole d'Italia non si dimostri agli ospiti nostri illustri e carissimi, eccessivamente riservato, come ha voluto essere in questi giorni. I signori Congressisti stranieri possano al loro itorno in Patria portare della nostra Italia non ingrato ricordo ; possano riportarne la impressione di un paese che studia et che lavora, di un paese che debba a buon diritto guardare all'avvenire, come appunto il nostro paese lo guarda con compiacimento sereno e con secura speranza.

Ma, Signori Congressisti e Signore Gentili, ancora un altro grande risultato nobilissimo et buono il Congresso internazionale di Navigazione deve portare et porterà. Coll'avvicinare fra di loro, col procurare reciprocamente la conoscenza, di persone distintissime di nazionalità diverse, il Congresso ha bene dovuto portare, ed ha effettivamente portato, alla più sincera reciproca stima, allo scambio geniale di relazioni di cortese amicizia : ed è questa — o Signori — la primissima condizione di quella sincera, viva e verace fratellanza fra i popoli, la quale assicurerà ed imporrà la pace feconda ed onesta al mondo intero.

Il Congresso dunque, anche al di là della Navigazione, ed al di sopra di essa, fu opera saggia, provvida et buona.

Con questi sentimenti, e con questi voti io porto a voi, signori Congressisti, stranieri ed italiani, il saluto deferente, il saluto

caldo et cordiale del Governo Italiano. E nel nome Augusto di S. M .il Re, al quale invio, col più reverente saluto, la espressione dell'animo nostro memore e grato, io dichiaro chiuso il X° Congresso Internazionale di Navigazione.

(Laud applause).

The meeting is adjourned.

EXCURSIONS

RECEPTIONS, EXCURSIONS AND TRIPS

According to the practice of preceding Congresses we endeavoured to offer our foreign guests some excursions, receptions and fêtes, in order to render their stay in Italy as pleasant as possible. We are not sure that we succeeded, but we tried to satisfy all tastes by making double excursions, some devoted exclusively to science, the others of a simultaneous nature intended for visiting picturesque places, noted for their natural beauty or their artistic merits.

HOW THE TIME WAS SPENT

Saturday, 23rd September 1905. — *Lunch offered by the delegates of the Italian Government to the Association and by the Local Organising Commission of the Congress to the foreign delegates*

Luncheon was served at one o'clock at the restaurant Cova. His Excellency Mr. Pozzi, under secretary of State for Public Works, drank a toast to all the participating members in the name of the Italian Government.

Mr. De la Porta, deputy Mayor of the town, followed suit by welcoming the foreign delegates in the name of the Municipality of Milan.

Then followed Messrs. Debeil and Quinette de Rochemont respectively in the name of the International Association and of

the foreign delegates, and lastly, Mr. de Timonoff, Director of Ways of Communication for the region of St-Petersburg, one of the Russian delegates, who spoke in Italian. We reproduce his toast to show our gratitude to Mr. de Timonoff for speaking so well on two different occasions in the language of Dante.

Mr. de Timonoff's toasts : —

Eccellenza, Signori,

La Russia ha un interesse speciale di seguire da vicino i lavori di Congressi di Navigazione nei diversi paesi del mondo che li ospita.

Possono immaginare quanto siamo felici che il Decimo Congresso si raduni in Italia che ci attirava da gran pezzo, non solamente per il suo glorioso passato, per il brillante avvenire che le assicura il lavoro assiduo d'un popolo libero e pieno d'ingegno, per le bellezze della sua ricchissima natura e per lo splendore della sua arte, — ma anche per la mirabile attività spiegata dagli ingegneri italiani in tutti i rami dell'industria del trasporto.

Sull' antico suolo dei Romani, che già due mila anni fa seppero creare dei porti di mare meravigliosi, regolare fiumi, dissecare laghi, costruire superbi acquedotti e canalizzare città, — su questo stesso suolo gl'ingegneri italiani hanno impiantato con invidiabile successo i prodotti della loro intelligenza e raccolto ricchissime messi che eccitano l'ammirazione di tutti i popoli.

Dal medio evo ai giorni d'oggi, da Michelangelo e Leonardo da Vinci, agli illustri ingegneri che sono la gloria dell' Italia moderna vediamo una serie continua di ricerche e creazioni di scienziati italiani nelle applicazioni delle forze naturali ai trasporti per acqua.

Fra le applicazioni dello slancio intelligente col quale gl'italiani hanno saputo e sanno trarre partito delle risorse naturali del loro paese, quella che interessa maggiormente gl' ingegneri degli altri paesi è la traduzione pratica ed utile in atto dell'invenzione geniale e feconda di Galileo Ferraris, il quale con le sue teorie ed esperienze sul campo magnetico rotante, ha condotto

alla risoluzione del problema importantissimo del trasporto dell' energia elettrica a distanza.

Statistiche recenti communicate alla stampa universale hanno fatto conoscere al mondo intiero come il nostro paese sia quello in tutta Europa nel quale vien utilizzata al massimo grado con impianti idro-elettrici la forza naturale delle cadute dei corsi d'acqua.

E questo fatto à il miglior indice del progressivo sviluppo industriale dell'Italia il quale a sua volta è caparra di prosperità economica e di miglioramento nell' ordine sociale.

Questa prosperità la auguro a nome della Russia e de' suoi delegati alla bellissima e grande Italia, e non posso terminare il mio discorso senza rivolgere alla gentile e benevola Assemblea la preghiera di participare con me al voto profondo e sincero che mi parte dal cuore :

Evviva l'Italia !

At two o'clock the guests left the restaurant Cova after having renewed old acquaintanceships, and after new introductions which brought together the guests of this luncheon which inaugurated the fêtes of the Congress.

Sunday, 24th September 1905. -- *Reception at the Villa Reale.*

At six o'clock, the Commission of Organisation gave a reception to all the members of the Congress in the reception rooms of the Villa Reale, lent to the Navigation Congress by H. M. the King. In the yellow drawing room, the principal presidents of the Congress, Mr. Colombo, Senator, Mr. Candiani, Senator, and the Mayor of Milan, Senator Ponti, did the honours The several eminent members of foreign delegations were introduced to each other by the general secretary M. Sanjust di Teulada.

The most cordial relations were established between the guests, who left the Villa Reale about eight o'clock, when the ice was broken, and all the members of the meeting felt like colleagues united for the common object of voting conclusions useful to science and their respective countries.

Tuesday, 26th September 1985. — *Simultaneous excursions to Lake Como and to the Electrical Works of Paderno and of Trezzo.*

1) Excursion to Lake Como.

The excursionnists started from Milan by railway to Lecco, a small town situated at the southern extremity of the left branch of Lake Como.

At Lecco they met their colleagues coming from Como who were making the journey in the opposite direction to visit the electric works at Paderno.

They went on board a special steamer which took them across to Bellagio, to the celebrated Villa Carlotta, where they had time to visit the world-renowned rich artistic collections, and lastly to the Villa d'Este. Luncheon was served on board and refreshments at the Villa d'Este. After having visited this Villa they went back to Como and thence by rail to Milan.

2) Excursion to the Hydro-electrical Installation of Paderno and of Trezzo.

The first excursion having a technical object was very successful, on account of the hospitality offered to the members of the Congress by the Italian Edison Electrical C° and by M. Cristoforo Crespi representing the Company which installed the electrical works at Trezzo.

The members of the Congress took a special train from Milan at 7 o'clock in the morning. They were received on their arrival at Como by the principal authorities.

At this charming town, on the shores of the lake of the same name, they went on board a special steamer of the Lariana C°, where breakfast was served. Much animation was displayed notwithstanding a strong wind and a little storm which rather marred the beginning of the journey. The steamer went round the lake, passing by Bellagio, and arrived at Lecco in triumph. All the inhabitants of the little town were in the square with the authorities and the members of the Congress were so enthusiastically greeted that they cannot easily forget the welcome.

Four large inland navigation boats were waiting at Lecco, specially arranged to contain the tables of the members of the Congress. These four boats tugged by motor boats left Lecco amidst enthusiastic acclamations and descended the course of the Adda between its green banks. They were greeted everywhere by the people along the shores with a warmth that delighted the excursionists.

The boats stopped at the commencement of the canal of Paderno on the Adda. The members of the Congress were able to see there the works carried out for damming the river and for the deviation of the canal which provides the motive power for the Paderno Works. They then left the boats and followed a rustic path which was rather difficult for the ladies and the less adventurous men, and which brought them to the Hydro-electric Works of Paderno where they could admire a complete and modern installation which gives 10,000 H. P. and which distributes the current to the Milan tramways and to the lighting of the town. At Paderno Mr. Esterle, advisory delegate to the Edison C°, Mr. Bettini, general technical manager of the Company, hospitably did the honours of their works by offering a lunch which was taken by assault after the country walk which had sharpened the appetite of the visitors.

After visiting the works, the Congress members went on board four large boats awaiting them so as not to waste time in passing the numerous locks of the Paderno canal. We must note that the Congress members and amongst them the eminent inspector general of the Ponts et Chaussées, Mr. Maurice Levy, observed with astonishment the old locks of the canal of Paderno which date back two centuries and which look as if they had been invented in our own times.

The Congress members boated down once more the course of the Adda, and admired the large iron bridge of Paderno, 150 metres span, and arrived at last at Trezzo, close to the old castle where Bernabo Visconti was killed. They also visited the hydro-electric installations of the company which propose to utilise the motive power of the Adda. This new installation which can supply 8,000 H. P. is not yet working. Though the works have but lately been begun they are nearly finished. Mr. Cristoforo Crespi and his sons, deputy Silvio and Dr. Daniel did the honours, offered much appreciated refreshments to the Congress members and accompanied them to the railway

station where they were entertained by a concert before their departure. On arrival at Monza they got into electric tramways which put them down at the Piazza di Duomo at Milan.

This excursion, which involved much labour in its organisation on account of the different means of transporting the 400 Congress members, was most successful, and we hope that it has shown how the spirit of organisation is being formed in Italy and how it is vieing with the more perfect methods in use in the north of Europe.

Wednesday, 27th September 1905. — *Garden Party given by the Local Commission at the Villa Reale.*

The Local Organising Commission which had given a reception on the arrival of the foreign delegates, was desirous of inviting once more all the Congress members to meet in the gardens of the Villa Reale which were decorated with garlands and the flags of all the nations represented at the Congress. An orchestra, hidden behind some bushes, played selections from an international repertoire.

Refreshment buffets and tables were set out in the gardens and the guests seated here and there spent a pleasant hour in friendly intercourse which should bring them closer to each other.

Thursday, 28th September 1905. — *Simultaneous excursions to Lake Maggiore and to the Hydro-electric Works of Vizzola.*

1) Excursion to Lake Maggiore.

At 7.30 a. m. the excursionists numbering nearly 400, went to the Northern Railway Station and took their places in the special train which was in waiting. Latins and Anglo-Saxons were soon cheerfully discussing the pleasant prospect of a sunny and breezy day spent on the largest of the Italian lakes which nature has so bountifully provided with beauty. Unfortunately the sky clouded over, and about an hour after the start a violent storm broke over the train, disappointing the ladies who had looked forward to seeing the beautiful sky of Lom-

bardy ; but the pouring drain did not destroy the good humour of the company. The tourists were only able to admire the rich villas of the plain through a thick curtain of rain. But on arriving at Laveno, the storm ceased and though the sun seemed reluctant to appear the travellers enjoyed the first impression of the beauty of the lake and the surrounding mountains. They then stepped on board two boats laden and decorated with flowers the « Verbano » and the « Francia » which were moored to the landing stage.

The members of the Committee in charge of the crew, Messrs. Medici and Belgiojoso on the Verbano, Guaita and Bertolini on the Francia, gave the order to start, and the two boats at 10.30 left the shore to go towards south. The old Austrian fort was passed, then the celebrated « Santuario de Ste-Catherine du Sasso ». Though the sun did not shine, the pure, sharp air gave an appetite to the excursionists who made a raid on the trays laden with sandwiches and pastry provided by the kindly forethought of the members of the Committee.

The Lombardy shore was followed, then along the Piedmont shore with its handsome villas ; Belgirate and Stresa were sighted as far as Isola Bella.

Here the excursionists were awaited by His Excellency Count Borromeo, who had sent a special invitation to the Congress to visit his historic palace. He acted himself as guide during the visit, with the extreme courtesy which is a constant tradition in this ancient patrician family.

The visitors admired in the numerous saloons of the splendid dwelling, the most precious treasures of Italian art, and a few of them were able to see the exquisite little chapel of the palace which contains the relics of St Charles Borromeo. In one of the ground floor drawing rooms refreshments were served to the numerous visitors who delighted with the beautiful things they had seen and the welcome accorded to them raised their glasses in honour of the lord of the renowned island who had, by his princely amiability, far exceeded the anticipations of the members of the Congress.

The repeated calls of the siren brought back the excursionists on board who were dallying in the cool paths amidst tropical plants and admiring the matchless panorama. Twelve o' clock had long ago struck when the boats left the enchanting isle ; hundreds of handkerchiefs were waved accompanied by hurrahs

in all the languages of the world. His Excellency Count Borromeo replied with smiles from the shore of his beautiful estate, satisfied at having received in his ancient house the representatives of the International Navigation of all the countries in the world.

The « Verbano » then went on to Pallanza and the « Francia » to Stresa to lunch. The local authorities were waiting for the excursionists at the landing place. Luncheon was served at the Iles Borromées Hotel at Stresa and at the Grand Hotel and at the Grand Hotel Eden at Pallanza. There were numerous toasts ; we particularly must note that of General Bigotti to the foreign delegates which was replied to in a genial manner by President Debeil. At 2 o' clock the excursionists returned on board to visit the upper part of the lake, passing by Ghiffa, Oggebbio, Cannero, noted for its mild climate and its lovely lemon trees, then by Luino, arriving at Laveno again after having had tea on board. At 5 o' clock a special train brought back the travellers to Milan at 7 o' clock.

2) Excursion to the Hydro-electric Installation at Vizzola.

On the same day a less numerous group (about 300 members of the Congress) accompanied by several members of the Organising Committee, started from Milan by special train at 7 o' clock by the electric traction line Milan-Gallarate ; in less than forty minutes they went through the most important industrial district of the suburbs of Milan, where a great number of factories receives electric power from the Hydro-electric Works which were going to be visited.

At Somma Lombardo, the railway was left in order to drive by numerous conveyances to the great weir across the Ticino which in conjunction with the waterworks takes the necessary water from the rivers for the Villoresi irrigation canal (40 cubic metres) and for the industrial canal of Vizzola (65 cubic metres). Near the weir where they arrived at 10 o'clock, the members were received by Mr. Scotti, engineer, general manager of the Vizzola C°, who, with his accustomed amiability offered his services to the visitors to give them all the technical explanations they might desire.

At the entrance to the canal, four large boats decorated with flowers and flags were boarded by the visitors who were then

taken to the works. During the trip luncheon was served, the sun came out and much animation presided at the meal.

On arrival at the works Mr. Scotti had the happy thought of giving the tourists the impression of passing through a lock eight metres high. This extra number, not on the programme, was appreciated by al. The installation was then visited, its imposing hall and its colossal turbines in motion impressed everyone.

The management kindly offered refreshments which were willingly accepted. The carriages were then taken by assault and the return to Gallarate was full of merriment, completed by the noisy and warm welcome of the inhabitants of the little town entirely devoted to up to date industrial enterprise.

The railway then took back everybody to Milan leaving a general impression that the visit had been too short.

Friday, 29th September 1905. — *Reception and lunch given at the Château Sforzesco by the Municipality of Milan.*

After the close of the Congress, the Municipality of Milan offered a lunch to the members and to the authorities in the ancient Château Sforzesco, recently restored under the artistic direction of Mr. Luca Beltrami, senator and architect. The halls, containing precious artistic and archeological collections were soon crowded by ladies and nearly all the members of the Congress. In the great hall of statues Mr. Ettore Ponti, senator and syndic of Milan, ascended on a platform,surrounded by the assistant mayors and the authorities, and glass in hand drank a toast to all the Members of the Congress and to the nations they represented so well. At the end of the toast the Members of the Congress went to the buffet prepared under the arcades of the *Rochetta* Court, in which the municipal band was discoursing sweet music.

The Local Commission of the Congress seized this opportunity with pleasure of thanking the Municipality of Milan for the part it had taken in the Tenth Navigation Congress and for all the kindness it had shown to the Congress members.

Saturday, 30th September 1905

1) Excursion to Pavia.

A special committee formed at Pavia offered to the members of the Congress, a visit to the Grande Chartreuse of Pavia, built by Giovanni Galeazzo Visconti about 1400 ; then to visit in part the navigation canal from Milan to Pavia and particularly its outfall on the Ticino ; and also to take a short turn in the old city of Pavia famous for its University, its old towers and its ancient churches. — About 150 excursionists took their places in the special cars of the Ticino tramway, which took them along the navigable canal from Milan to Pavia, to Torre del Mangano, that is to say to the *Certosa* station. After having visited the monument, the members went on by the same train to Pavia to the University where luncheon was served in the *aula magna* the Municipality being hosts.

Mr. Zacconi, syndic of Pavia, Messrs. Pavesi, Lanzoni, Sapi, Benini, engineers, General Bigotti, and Messrs. Tavernier and Herman drank much applauded toasts. Finally, the company went to the covered bridge of the Ticino and embarked in two boats as well as in some craft belonging to the Club des Canotiers, and sailed down the Ticino as far as the mouth of the Milan canal where the boats went through two locks. When back in town the excursionists visited St Michael, the Cairoli monument and the castle of Jean Galeazzo Visconti.

Then they went back in the evening to Milan by special tramway cars. The Pavia Local Committee deserves the sincere thanks of all the visitors for having arranged a pleasant trip which enabled many members of the Congress to visit the mouth of the best navigation canal of the province of Milan.

2) On the same day, Saturday, a more numerous group of members of the Congress went to Genoa, Spezia and Naples to visit the maritime harbours of these three towns.

The Commission in charge of this important excursion had a certain difficulty in executing the official programme. Only one of the large passenger steamers of the Italian General Navigation C° had been chartered as the number of guests was to be limited. During the last days so many registered in such an unexpected proportion that in order to satisfy all demands the

Commission improvised a supplementary service and chartered two spare steamers.

On 30th September at 7 o' clock in the morning the excursionists started from Milan by special train for Genoa under the direction Mr. Umberto Campanari, barrister, Prince Emile de Belgiojoso d'Este, D° Giulio Guaita, directors of the railway.

At the Genoa station the travellers were awaited by a delegation of the Municipality including the assistant mayors Marquis da Passano and Commendatore Beppe Croce, by a number of Municipal Councillors and by a delegation of the most eminent representatives of Commerce and Industry.

The Congress members were driven to their respective hotels in carriages sent by the Municipality for the purpose. During their short stay in the town they had free passes on the tramways and free entrance to the museums. In the course of the afternoon they visited the port works by invitation from the authorities.

Refreshments were served at the end of the visit in the St-George Palace where the reception rooms had been decorated for the occasion.

During the evening the Municipality gave an official reception at the Town Hall, formerly Tursi Palace ; those who took part in it will long remember the gorgeousness of this assembly.

The pro-syndic, Marquis da Passano, welcomed the guests and gave to each a valuable souvenir, the fac-simile of three autograph letters by Christopher Columbus which are preciously kept in the Municipal Archives.

Mr. Dufourny, General Secretary of the Permanent Association of Navigation Congresses, returned thanks for the touching welcome of the City of Genoa. This is the speech of the eminent technical expert who represents so well the great International Association : —

Presidents and Members of the Municipality of Genoa,
Ladies, Gentlemen and dear Colleagues,

On our arrival at Genoa we received at the outset an amiable, sympathetic and cordial welcome for which we are touched and grateful.

We expected it for the courtesy and hospitality of the city of Genoa are well known and far famed. That is the reason our Association accepted with the greatest pleasure the amiable invitation you so kindly sent.

We all of us were anxious to see, contemplate, and admire « Genoa the Superb », glorious, famous, illustrious in history, whose origin is lost in the dark ages. Genoa, the port of Liguria, the heroic city of the middle ages, the land of painting and the arts, the land of commerce, « the Queen of the Levant », the birthplace of the illustrious Columbus the pre-eminently maritime city since thousands of years.

It was almost a duty on the part of our Association to visit your town and harbour, your harbour which now occupies the very first place in the world's maritime commerce.

We knew that when we came here we should see life, energy and initiative in full swing, we knew that all here and particularly you who control the destinies of the town and port, you are all active, enterprising, daring, that you have no other care but that of upholding the glory and wealth of the City, that you crave for progress and extension, that you always look ahead and more forward. Under the sway of such men, the port of Genoa cannot but continue to prosper and its traffic still increase. That is our wish and we are the more certain of seeing it realised that in all directions we see the Alps being tunnelled, we see subterraneous ways bored in such a daring manner that the world marvels and through which, like torrents, pour the freights of Central Europe towards Genoa and towards central Europe the merchandise of the Levant by the port of Genoa.

I am certain, Mr. Syndic and members of the Municipality of Genoa,I am certain of being the mouthpiece of all my friends, of all my Colleagues of the Association after the admirable Congress held at Milan under the high patronage of the King of Italy, after the splendid reception that you have given us, I am certain of being their interpreter when I say : Long live Italy ! Prosperity to the port of Genoa !

After the reception, the Congress members went on board the three boats *Sirio*, *Orione* and *Adria* in order to weigh anchor very early next morning for Spezzia to visit the Royal Naval Arsenal of the town.

A glorious sun promised a delightful journey along the lovely *riviera di Levante* of the Gulf of Genoa : Unfortunately after a few hours navigation the sea was so rough that the pitching caused much discomfort to the less hardy ones. Landing at Spezzia would not have been so easy but for the kind arrangements of the officers of the Royal Navy and of the Local Committee of Spezzia.

The travellers were received on landing by His Excellency Mr. Morin, Commander of the Department and by Syndic Marquis de Nobili with whom were all the civil and military authorities.

Mr. Campanari did the official introductions ; His Excellency Admiral Morin welcomed the members of the Congress ; everybody then went to the Casino Civico where refreshments were served.

Mr. Dufourny expressed the feelings of all the members of the Congress in the following speech :

Messieurs Syndic, Admiral and Authorities of Spezzia,
Ladies, Gentlemen and dear Colleagues,

I did not expect to have the honour of addressing such a numerous assembly, or rather, I did not expect all the honours offered to the members of the Congress by the inhabitants of Spezzia.

You came in your numbers to receive us on landing, you conducted us in procession, followed by an immense crowd, to this handsome hall so brightly decorated and ornamented by international flags, dear to our hearts.

Your kindly receive us with the most charming and most flattering compliments of welcome.

How I regret that I cannot answer in such eloquent terms as yours. You are all in Italy past masters in the art of speech and we are only engineers, workers.

Therefore excuse me and I shall merely say, very simply, in the name of the members of the Congress, how very grateful we are for the delicate attentions we receive, for the trouble we give, for the kind words addressed to us, and for the truly fraternal welcome we have had here.

We are touched by your fine reception and also by the exceptional favour granted us by the Naval Engineering Department, of opening to us the Naval Yards of Spezzia noted all over the world for its technical staff as well as for its noble constructions.

We shall be able to appreciate and judge of the Italian Navy which an intelligent and foreseeing Government increases in power daily so that it may cope with modern necessities and the defence of the country.

Our best wishes for the greatness of Italy and its fleet, and from our hearts we cry hurrah ! for the City of Spezzia and for our dear and illustrious colleagues of the Italian navy. *(Applause.)*

After the reception the Arsenal was visited ; the Local Commission made it as pleasant as possible.

But the sea was still rough ; some of the travellers preferred to go to Naples by train. The others went on board the *Sirio* and the *Orione* and courageously defied Neptune's anger.

At Naples the travellers by sea and the travellers by land met again.

The weather which had been so unfavourable on arrival (a drenching shower of drain coming over Naples and hiding its beautiful blue sky) cleared the next day and allowed a visit to the port works, an interesting excursion to Pompeï in truly Neapolitan sunshine, a visit to the town, the gulf and the islands.

Prince Belgiojoso in the name of the Milan Committee offered a banquet to the delegates of the different states and to the authorities of the town. This closing banquet during which the greatest animation prevailed cemented the entente cordiale of all the guests. Mr. Dufourny spoke again in the name of the Association and made the following speech : —

Messieurs Syndic and Members of the Municipality of Naples, Ladies, Gentlemen and dear Colleagues,

I wish to add a few more words to the eloquent speeches of my eminent colleagues from England, Germany, France and Russia, a few words in the name of the Permanent International Association of Navigation Congresses to close the excursions of the Tenth Congress and to tell of its success.

We have now arrived at the end of our long voyage in Italy. Each of us will soon be home again and like the Magi on returning to their kingdoms relating on their way all the wonderful things they had seen in Judea, so shall we proclaim all the wonders we have seen in Italy.

We shall tell with what pomp and circumstance the Tenth Congress of Navigation was held at Milan.

We shall tell how the King and Queen of Italy, who have been admired by the whole world during the events in Calabria, for their brave and chivalrous spirit, whose kindness of heart and munificence are only equalled by their simplicity, kindness and love of science and all that concerns the intellectual and economic development of their country, deigned to honour by their presence the opening ceremony of the Tenth Congress.

We shall tell also of the technical and scientific knowledge ; the cordiality, the amiability and the extreme devotedness of all the organisers of the Milan Congress.

The King's Ministers, the highest functionaries, the Senators, the Princes, our friends and colleagues the engineers, all the authorities did their utmost in Italy to render our voyage fruitful and interesting.

The Magistrates of the towns, the Representatives of the Municipalities of Milan, of Genoa, of Spezzia, invited us to splendid receptions for which we again wish to express our gratitude.

Finally, ladies and gentlemen, to overwhelm us with attentions and kindness, to offer us the most beautiful the most grand and the most enchanting spectacle in the world before our departure it is Naples the incomparable, Naples the most beautiful, with its unique gulf, Naples the abode of Lucullus, Augustus, and Virgil, Naples which we see in high festival, radiant in all its magnificence, with that immense lighthouse which rumbles and shines with a thousand lights as if to salute our presence.

Town of Naples, Magistrates of Naples, we thank you for your welcome. We have seen you, beautiful town of Naples, and we should not wish to die now so that we might preserve an eternal remembrance of your beauty, your hospitality and your kind reception.

Beautiful Italy, we have admired your renovation, progress, union, strength, power, once more we salute you and in the name of the Permanent International Association of Navigation

Congress, as we are closing the Tenth Congress and its excursions, I say : Long live Italy ! Long live the town of Naples !

After this the Congress members took leave of their Italian colleagues with the wish to soon meet again at the Eleventh Congress !

Sunday, 1st October 1905. — *Trip on the Pô and to Venise.*

About two hundred members of the Congress, amongst whom were Mr. Debeil, one of the Presidents of the Association, Messrs. Piola-Daverio and Sanjust di Teulada of the Local Committee, who were in charge of the excursion, got into a special train at six o'clock in the morning, which passing by Bologna was to take them to Pontelagoscuro near Ferrara, on the Pô.

The journey by train was accomplished with the desired punctuality ; at Pontelagoscuro two steamers adorned with flags were waiting for the passengers who received on embarking a basket of provisions for breakfast.

Animated groups were soon formed on the steamers which satrted at once down the Pô assisted by the current of the tide, and the members of Congress whilst admiring the green banks of the River discussed their breakfast.

A few trading vessels loaded with merchandise coming up stream were met, and after one hour's navigation Polesella was reached where a second train carried the members of Congress to Chioggia.

This picturesque little town on the lagoon, with its ancient buildings of the time of the Venetian Republic, its little canals, its bridges and its fishing boats with multicoloured sails, was entered in a very lively manner. A flourish of trumpets went in front of the travellers and accompanied them to the Town Hall where the Mayor in a hearty, improvised speech, welcomed them in the name of the town. After luncheon served in the grand saloon of the Town Hall, all the company went to the bridge to board two steamers of the Lagoon C° in waiting. The members of Congress being in haste to come to the end of their journey soon crowded on them. On deck they found a concert and a refreshment buffet : after a two hours pleasant

trip, the spires of Venice appeared, then the town came out suddenly from the waters of the lagoon and presented itself to the travellers in all the magnificence of its ancient palaces and churches, gilded by the setting sun which made the bright cupolas of the old basilica of San Marco glisten.

When the members of the Congress set foot on the Riva degli Schiavoni, twilight had fallen on the Queen of the Adriatic ; the company soon dispersed in the different hotels where rooms had already been booked and where the luggage sent direct from Milan had arrived.

The next day the members of the Congress visited the port, the floating dry dock, the Maritima (the commercial docks), a cement factory, a large mechanical mill, the silos for wheat ; the visit terminated at the Lido where luncheon was served under the auspices of the Milan Committee. All the authorities of Venice took part in the luncheon which was laid for about three hundred persons.

At dessert, Mr. Piola and Mr. Romanin Jacur for the Organising Local Committee, made speeches. Mr. Debeil replied in the name of the Association in the following toast : —

Mr. Mayor and Members of the Municipality,
Ladies and Gentlemen,

Since their arrival in this wonderful Italian country, the members of the Congress of Navigation have been the recipients, everywhere, of delicate attentions, charming and cordial receptions, and the days pass by with wonderful rapidity thanks to the excellent and judicious arrangements for spending the time, serious and active work always receiving its reward the next day in the pleasure of a charming, interesting and restful excursion. Thus after the final sitting of the Congress the members separated into two groups. Some have gone south where they are now visiting the fine port of Genoa and admiring the artistic riches of the town, and then they will go to Naples, the queen of the south, to conetmplate its splendour.

Others preferred to visit the Pô, that fine river which when its improvement and canalisation are effected, will contribute

largely to the public wealth, and will bring abundance to the northern districts of Italy.

Finally, they bring their excursion to an end by saluting and admiring the queen of the Adriatic, the beautiful and superb Venice with its glorious historical past, with its grand and sumptuous monuments, Venice, whose arts and commerce once upon a time threw an incomparable radiance over the whole world. It is here then, in Venice itself, that we are greatly honoured by being received to-day by the municipality of the noble city. As President of the Permanent International Association of Navigation Congresses I salute Mr. Mayor Count Grimani as well as all the members of the Municipality of Venice, and express our feelings of deep gratitude and our warm and enthusiastic thanks for their brillant and sympathetic reception, the remembrance of which will never fade from our hearts.

I will conclude, ladies and gentlemen, by hoping that Italy and all the nations will benefit in a large measure by the work of our Navigation Congress, that by a careful study of all questions relating to transportation by water constitutes the most powerful and efficacious factor for the development of relations between the different nations and consequently for the establishment of concord and universal brotherhood.

(Prolonged applause.)

After luncheon, the *Murazzi*, that is to say, the ancient defences of the shore between the Adriatic sea and the lagoon were visited, then the Lido harbour and the little town of Pallestrina, where the ladies were able to admire a collection of lace from the celebrated manufactory of Mr. Jesurum. After the visit to Pellestrina they returned to Venice. The third day was to be devoted to the artistic trip offered by the Municipality of Venice. The glass and mosaic manufactories at Murano were visited also the lace manufactories of Burano and the ancient basilica of Forcello which with its little museum called forth the admiration of the visitors.

In the evening the Municipality of Venice gave a reception in its splendid palaces on the Grand canal ; a classical serenade was arranged for the visitors, it glittered with the light of its many lanterns and sent the notes of its concerts as far as the Town Hall crowded by admirers. Refreshments were served

and all the members of the Congress left the reception rooms of the Municipality deligted by the splendid welcome they had received in the ancient city of the Doges.

On the fourth day the members of Congress separated. It was with regret that they saw the termination of this memorable gathering which has inaugurated a new cycle of Navigation Congresses under the high patronage of the International Association of Brussels.

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